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MECHANICS' REGISTER.

JULY, 1839.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Further Notice of the Fallacies of Mr. Espy's Examinations of Storms. By W. C. Redfield.

Storm of August 17th, 1830.—When my last remarks on the fallacies of Mr. Espy's examinations of storms were sent to press, his comments on this storm, in the May number of this Journal, had not appeared. The readers of the journal will not find, however, in this closing portion of Mr. Espy's examinations, any return to the correct principles of critical analysis, nor any facts which invalidate my former conclusions in regard to this storm.

Could Mr. Espy have shown that the distinctive features of this storm had not been clearly developed or rightly apprehended, and, by a more strict analysis, have pointed out the error of my previous inductions, his labours might have proved of some benefit to the cause of science. But the attempt to merge all the distinctive and well marked phenomena of this storm into one chaotic mass of generalities; to confound one of the most strongly marked hurricanes of the Western Atlantic, with the clouds and rain which occurred the same week at certain localities; and to mingle this hurricane with the phenomena of another, which followed a few days later on a different track, can neither add to our knowledge, nor settle a controverted question of fact. Yet his professed examination of this storm is liable to even more than these objections; while he sets out with new and fancied conclusions, which appear at variance with the great mass of observations which he has recited.

After the exposition which has been made, in the May and June numbers of this Journal, of the errors of Mr. Espy's previous positions and examinations, it cannot be expected that I should follow him in detail, through

the mazes of error and confusion into which he has fallen; and the pointing out of a few more of these errors will suffice to show that his conclusions, in regard to the distinctive phenomena of our great storms, cannot be relied on.

Mr. Espy sets off with the affirmation, that "this storm, if indeed it was one, and not many, was upwards of 1000 miles long from N.N.E. to S.S.W., and at least five times as long as it was broad on the 17th." [!] It is true, that at least three hurricanes passed our coast in the month of August, 1830; but it is too late to attempt the blending of these separate and distant storms into one grand but indeterminate generalization, as Mr. E. has done with some other cases, in his capacity of meteorologist to the joint committee. But what is the evidence by which such a remarkable elongation in this storm is supposed to be established? Simply, that the brig Mary took the gale on the 14th, in lat. 27° 55′, lon. 76° 50′, which Mr. E. says, "lasted till the 17th, and that on the same day, the storm was felt at several points N.N.E. of brig Mary, as far as Long Island Sound." To this sweeping method of settling this important question, I have several objections.

1. The points at which the storm is mentioned on the day of the 17th, are all northward of Cape Hatteras, which itself is little more than *four hundred* miles from Long Island Sound; and the storm did not reach the latter till late in the day, after having left the former region. 2. In nearly five pages of summary recitals of the phenomena of this storm, which are quoted by Mr. Espy, we find nothing to confirm this statement of three days duration; while in several of these it is expressly stated as being less than 24 hours. 3. The brig Mary, when in the gale on the 14th and 15th, was near the latitude of recurvation, (30°) where the duration of the gale is often increased. 4. The report of the brig Mary does not state that she was in the gale on the 17th, which must have been impossible, according to numerous and detailed accounts. This report, as I find it, and as afterwards quoted by Mr. Espy, says, that the Mary "experienced a tremendous gale on the 14th," &c., "which lasted three days." Thus, if there be no greater error, it must simply mean a portion of three several days, according to verbal usage from time immemorial, i. e. beginning, probably, on the evening of the 14th, continuing through the 15th, and ending on the morning of the 16th. As the vessel was then steering for Charleston, under the heel of the gale and the power of the gulf stream, this duration, on a rapid course to the northward in that region, is sufficiently conformable to the other facts obtained. But to assume, as is boldly done, that the storm extended, on the 17th, from Long Island Sound to the first position of the Mary, is to nullify nearly all the other accounts of this storm. What credit can be claimed for the conclusions of a meteorologist, when arrived at in this extraordinary manner?*

But this is not all; for, as if the above assumption was not sufficiently at

* On examining the report of the brig Mary, as published in the newspapers, I find it also states, that on the 17th, at 10 A. M., 60 miles S. of Charleston light, the Mary took off the crew of the Br. barque Prospect, which was in a sinking condition; "she having experienced the same gale on the 15th and 16th." Thus, instead of having "lasted *till the 17th*," the report itself shows that the gale terminated in that quarter on the 16th!

The schr. Ward, which took the gale in the same region, reports its duration at 36 hours, which agrees with my explanation, and shows that it must have ended early on the 16th.

variance with the facts of the case, we are next told, that "on the 18th, its length [that of the storm] appears to be still greater, for it seems to have reached from lat. 28°, lon. 66°, where the wreck of the Julia was seen on that day, [?] to lat. 41° 20′, lon. 65° 25′, where the hurricane was tremendous from N.N.E."

The reader will be equally astonished with myself, at finding, on research, that this second attempt to elongate this storm, is founded on nothing more than the simple fact, that "*the Ceres fell in with the wreck of the Julia*, in lat. 28°, lon. 66°"!—as if meeting a wreck, proved the presence of a hurricane!*

Had our sagacious examiner but noticed the log of the Blanche frigate, which is given in the work which he was professedly examining, he would have found, that in a position some hundreds of miles nearer to the storm, this ship had no gale on the 17th or 18th; and that on the latter day, she had the winds "moderate," "light airs," and "calm."

Thus, we have no need to settle the pretty speculation, "whether this storm traveled side foremost exactly, or not:"—nor can we find reason to doubt, that on the 17th and 18th, "it certainly moved towards the eastward!"

The discrepancies of one or more hours in the common newspaper accounts of the beginning of the gale, at different towns in the Carolinas, do not require any consideration, as we have in our hands the data for their correction. A little research would have satisfied Mr. E., that the statement which fixes the storm at Wilmington, N. C., on the evening of the 15th, was a typographical error of one day: the true account says on the 16th, in accordance with the reports from other localities.† Besides this and like errors, Mr. Espy quotes those marine reports in which the date is given in nautical time, without correction; in cases where the fact is perfectly obvious. We find in his additional collections, scarcely a new fact that bears on the case, chiefly for the reason that the most important of these were already embodied in my statements; while errors in date, the want of geographical and consecutive arrangement, and the placing in juxtaposition of distant and irrelevant phenomena in these additions, are well calculated to promote the same degree of confusion in the mind of the reader, that appears to exist in Mr. E.'s own conceptions of this storm.

As instances of the confusion produced by juxtaposition, and the error or omission of dates, the following may be noticed:—

"On the 18th, in lat. 43°, lon. 58°, heavy gale from the southward. Off the Highlands, blowing very heavy from the northward."‡

This, when correctly exhibited, proves to be the report from the packet ship Edward Bonaffe of the gale on the 18th, with the additional but irrelevant fact, that on arriving off the Highlands, *about ten days later*, the ship split some of her sails, the wind blowing heavy from the northward!

* National Gazette, of Sept. 30, quoted by Mr. Espy. The account, *in extenso*, as I find it in the New York Gazette, of Sept. 28th, is as follows:—"Br. barque Ceres arrived at St. Andrews, N. B., 18th Sept. from the West Indies. In lat. 28°, lon. 66°, fell in with the wreck of schr. Julia, of Newbern, N. C., and took from her some pork, lard, &c.; also the crew of said schooner, excepting the captain and one man, lost. The Julia was lost in the gale of the 20th of August."

How could such a statement have been made the basis of so important a position relating to the extension of the hurricane which was off Nova Scotia, on the 18th?

† See New York Evening Post, August 26th.

‡ May number of this Journal, p. 294.

Of the same character is the fact, that "at New Orleans it blew a gale between the 15th and 20th."

Of Mr. Espy's errors in date or geographical position, I will only mention further, his position of the ship Brilliant, on the 18th, in lon. 71°, bound to Philadelphia. This ship, I find, is reported as being spoken by the brig Othello from Bremen, on the 18th, in lon. 64°. Also, the Henry Astor, on the 19th, in lon. 68° 24′, (?) *on her route from New Orleans to New York!* These and like errors and crudities, ought not to have been thrown as stumbling blocks in the path of scientific investigation.

The wholesale generalizations, "that on the 17th, the wind on the Atlantic, some distance from the coast, was blowing from the S.E. all the way from Georgia to Maryland, and at the same time on shore for that whole distance, it was blowing from the N.W.; and that N.E. of Maryland, as far as Long Island Sound, the wind was N.E.," &c., are of the same general character with other phenomena which he has alleged as occurring "at the same time," and which have recently received our consideration.* It will appear, on strict examination, that here was the regular action and progress of a whirlwind storm; the wind *blowing across the centre of its path*, first from S.E., and last from N.W., in regular succession, from Georgia to Massachusetts; and that after passing Virginia, the storm so far left our shores as to blow from the N.E. on the land and near the coast, or *retrograde* to the course of the storm; while on its opposite margin, at sea, the wind blew from the S.W.: all which demonstrates the rotary character of the storm. Are we to suppose that the *accepted test* for the two theories was forgotten by Mr. E., while penning the above generalization?

Mr. Espy sums up the results of his professed examination of this storm in the three following positions:—

1st. That "the storm was several hundred miles longer from N.N.E. to S.S.W., than it was from W.N.W. to E.S.E." We have seen both the error and futility of this conclusion.

2d. That "it moved eastward with a velocity not exactly ascertained," &c. That it moved eastward in these latitudes, has been known since 1830; and its velocity, having been observed through a course of near 3000 miles, is better understood than Mr. E. appears willing we should believe.

3d. That "the wind set in generally, out at sea, from the S.E., and changed round to N.W." This appears a correct, but fatal admission. Has Mr. Espy forgotten the storm of 1821, which he strenuously contended, never changed from S.E. to N.W.? In view of this admitted fact, what becomes of the centripetal theory?

I had long been curious to know, how Mr. Espy would deal with the facts which pertain to this storm of August 17th, 1830, and other distinctly marked hurricanes: but must now acknowledge that I did not anticipate so complete an evasion of all the distinguishing points at issue, and so barren an effort at confusing and mystifying the most distinct phenomena of this storm, as is manifested in his present examination. We are greatly indebted to him, however, for having spread before his readers, though in an exceptionable manner, a summary of the principal facts in relation to this storm: many of whom will doubtless investigate the subject for themselves, free from the bias of a preconceived hypothesis.

New York, June 26th, 1839.

* See the refutation of Mr. Espy's positions relating to the storm of Sept. 1821, in the May and June numbers of this Journal for the present year.

Experiments on the Porosity of a Mass of Cotton.

To the Editor of the Journal of the Franklin Institute.

Sir:—

Perhaps you may consider the following pretty experiment on porosity, worthy of a place in your Journal. Fill a common glass tumbler, or other vessel, completely with some spirituous liquor, so that a few drops more would cause it to overflow. This done, you will find no difficulty in introducing into the tumbler, so filled, *a whole handful of raw cotton.*

This experiment was suggested by the accidental recovery of some wet cotton from a boat which had been sometime sunk in the Tennessee river; it was found by the workmen that after they had squeezed out the water from some cotton, the vessel in which it had been contained, remained nearly as full as before the cotton was removed.

Spirits answer better than water, for trying the experiment, from the rapidity with which they are absorbed by the cotton. Several theories were started by persons who tried the experiment; such as, that the filaments of cotton occupied the vacancies between the globules of water; or that by its capillary action, the cotton subdivided the globules, and caused them to occupy a less space, &c.; to me, however, it appears to be accounted for more satisfactorily, by supposing the fluid to insinuate itself between the filaments of cotton, and thus permit the latter to occupy no more space than is due to their actual solidity. The experiment is certainly a beautiful one. Very respectfully, yours, &c.,

John C. Trautwine.

Knoxville, Tennessee, June 12, 1839.

Bibliographical Notices.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Foulston's *Public Buildings in the West of England.*

The author of this work, in his address to the public, only claims regard for the construction and adaptation of the classical forms of architecture to the buildings which he has rendered suitable for modern purposes, and very properly declines any merit in the originality of his designs.

His taste for Grecian forms, exhibited particularly in his buildings of the Royal Assembly Rooms and Theatre at Plymouth, wherein the Doric Portico at Athens, the Ionic of Illyssus, and the Corinthian of Lysicrates, are introduced, is well and skilfully managed, but the author can scarcely be allowed the liberty he has taken in varying the proportions, and admixing, in his adaptations, the prominent features of these sacred edifices. His example of the *Doric Portico* is *too robust*—the columns are at least *one diameter too low*, and the assemblage of windows and doors of the façade of the cell is entirely inconsistent and heterogeneous. The bases of the columns of the *Ionic of the Illyssus belong to the Corinthian of Lysicrates;* and the author's restoration of the *Cyma* is novel, but we may venture to inform him that a repetition of the members of the level corona, in this example, could never have belonged to the original cornice. The *Corinthian of Lysicrates* is tastefully and prettily arranged in the ball room.

The designs of *St. Andrew's Chapel* are fantastically Grecian and Romanised:—there is an evident struggle with the various parts of this composition which shall be most prominent, and the perilous situation of the sounding board over the pulpit, is much more certain than that of the galleries, which are supported, whimsically enough, by the slender stalks of the Italian candelabra.

The author solicits attention to the distinctive peculiarities of his designs for the Cornwall Lunatic Asylum and Bristol Gaol. These designs are similar in point of ground plan arrangement, and possess much more merit in the details of their construction than in any other distinctive mark. The peculiarities of the general designs are in every respect like those of the Eastern Penitentiary of Pennsylvania, by Mr. Haviland, but not so extensively or perfectly arranged as in this building.

The author's impression for producing a picturesque effect by "*combining in one view*," the different orders and styles of architecture, which, as he says, *has not been before attempted*, is, to say the least, a very doubtful one, even according to his own showing. We would apprise him, however, that the idea of congregating the orders of architecture *in one group* is not new, but has been carried out practically, and, as we think, with an unhappy effect, some 20 years ago, by Mr. Jefferson in his collegiate buildings of the University of Virginia.

The work before us, however, contains very many chaste and graceful outlines, extracted and compiled from classical examples, together with some practical information given in the "*details at large*," which cannot but be of essential service to the young student of architecture.

The Builder's Port Folio of Street Architecture. By J. Collis.

We have examined this work, which, according to the title, consists of "*a series of original designs for fronts of houses of all classes.*" In the composition of these designs, we recognise nothing but that sort of originality which belongs to the depraved state of the architecture of Regent street, in London.

It is to be regretted, that in this composition the rage for the whimsical and fashionable profusion of ornament, should not be confined within doors, and not worn out on the street.

We would, if we could, say something in praise of this work, but we are at a loss in any attempt which might be made to excuse the fickle and uncontrolled range of the author's genius;—we are also at a loss to know why *street architecture* should differ from any other class of buildings that should not be submitted to the settled rules and proportions as well as all objects within the range of the builder's art.

Franklin Institute.

Conversation Meeting.—Dr. Hare's new Eudiometer.

At a Conversation Meeting of the Institute, held May 23d, 1839, Dr Hare exhibited an improved aqueous, sliding-rod, hydro-oxygen Eudiometer, and stated that this instrument enabled him to analyse the air accurately within thirty seconds. Being, however, made to be used with water, accu-.te results could not be obtained by it when carbonic acid was one of the

products, of which an accurate measurement would be necessary. It would of course be impossible to ascertain how far an absorption of this gas by water might add to the absorption resulting from the combustion and consequent condensation of hydrogen. Hence, in order to analyze gaseous carburets, another eudiometrical instrument had been constructed many years ago, in which mercury was the confining liquid. The mercurial sliding-rod eudiometer, now laid before the Institute, was an improved modification of that instrument. The pressure within the receiver of the apparatus in question being varied, (by pushing in or pulling out the rod through a collet of leathers, or stuffing box,) a communication was successively made, by means of cocks, with a reservoir of the gas to be analyzed, a reservoir of oxygen, and with a receptacle of carbonic acid: an appeal was made intermediately, in each case, to a mercurial glass syphon gauge, in order to bring the density, at the time of admeasurement, to the atmospheric standard. The ignition of the gaseous mixture was effected by means of the discharge of a calorimotor through a platina wire.

These preliminary explanations being made, the process for analyzing the carburetted hydrogen furnished by the Gas Light Company, was then performed by Dr. Hare's skilful and intelligent assistant, Mr. J. Bishop.

The following results were obtained, agreeably to several experiments in which the condensation and absorption were the same.

The oxygen employed having been first analyzed, by igniting it with three volumes of hydrogen, was found to contain four per cent. of impurity.

The gas exploded with the oxygen imparted to it, one measure of impurity for every 20 measures employed.

Hence, 20 measures being assumed as representing one volume, in order to have that quantity of pure gas, 21 measures were taken into the eudiometrical receiver, and were mingled and ignited with seventy-five measures of oxygen.

A condensation of thirty-five measures was found to ensue—one volume, or twenty measures, being attributable to the disappearance of the gas—since by its conversion into carbonic acid, oxygen undergoes no change of volume. Fifteen measures out of the thirty-five were to be ascribed to the oxygen consumed by hydrogen. But fifteen measures of oxygen require thirty of hydrogen, equal to a volume and a half; and thus it appeared that this last mentioned quantity of the last mentioned gas existed in the volume of gas subjected to analysis.

The residue, after being well washed with ammonia, was found to have lost fifteen measures, which, containing, agreeably to the known composition of carbonic acid, a like volume of carbon, represents the quantity of this element in the gaseous volume subjected to examination.

It follows, that there are three-fourths of a volume of carbon, and one and a half of hydrogen, condensed into one volume of the gas; so that in four cubic feet, there are three cubic feet of carbon, and six of hydrogen.

The gas obtained by passing the vapour of alcohol through a porcelain tube, has been found, by Dr. Hare, to contain a volume of carbon and a volume of hydrogen condensed into one volume. That obtained from the same liquid by sulphuric acid, usually known as olifiant gas, and with which the former has been compounded, contains two of carbon and two of hydrogen in one volume, as is generally received.

The gas light gas therefore contains twice as much hydrogen in proportion to its carbon, as those above described, and this might have been inferred from its being sufficiently buoyant for balloons, agreeably to Mr. Wise's

æronautical experience. As the excess of hydrogen tends to lessen the liability to smoke, it is presumed that the gas, as constituted, may be preferable, for the purpose of illumination, to such as contain a greater proportion of carbon.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Richards' Process for the Manufacture of White Lead.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom was referred for examination a process for Manufacturing White Lead, invented by Mr. Richards, of Philadelphia, REPORT:—

That the extensive employment of white lead in the arts, and the well established deficiencies in all the processes hitherto adopted for its manufacture, induced them to institute a more critical examination of the process proposed by Mr. Richards, to supersede the method ordinarily pursued.

According to this process, the necessary apparatus consists of one chamber within another, the inner or lead chamber being tiled on its inner side, and completely surrounded by a twelve inch bank of tan on the sides, floor and roof, between which and the outer chamber, steam is allowed to circulate to maintain the temperature of the lead chamber at an elevated point. The sheets of lead are rolled up in the ordinary manner, flattened at one end, and set upright on the other on floors or shelves. A trough crossing the centre of the floor of the inner chamber, contains the vinegar, and may be said to have a double bottom, from small openings on either side of which air and carbonic acid are forced into the chamber. A similar hollow beam crosses the roof, permitting the entrance of steam from small lateral openings. For the first twelve hours after setting the lead, steam is allowed to enter, mingled with a small quantity of air, giving the lead a greyish white surface, while the mass remains unaltered. Acetic acid is now introduced into the trough, and steam and air continued for three days. During the following sixteen days, vinegar is still added, till the whole has amounted to one pint for three pounds of lead; and at the same time the steam is continued, while air and carbonic acid are forced into the apartment, the latter being generated by the combustion of coke. After these operations, the surface of the lead is greyish white and somewhat hard, the interior of the sheet containing, still, metallic lead. Up to this point, a period of twenty days, the temperature has been maintained at 120° Fahr., but during the remainder of the process, it should not be higher than 80° to 90° Fahr. During the remaining 15 days, equal volumes of air and carbonic acid are forced in, and a small quantity of steam admitted. The whole process, therefore, requires thirty-five days for its completion, when, if it has been well conducted, the surface of the lead will be covered with minute blisters, otherwise large scales of a white compound, probably an acetate, stand off from the surface of the metal.

It is generally acknowledged by those who have investigated the manufacture of white lead by acetic acid, that the theoretic character of the process is involved in much obscurity. The experience in Europe, as deduced from direct experiment, has been that the entrance of atmospheric air tends to darken the colour of the resulting white lead, but Mr. Richards asserts that he cannot succeed without it; and yet it is difficult to explain its action,

excepting by its assisting in the oxidation of the metal. If oxidation proceed from the vapour of water or vinegar, we must suppose the disengagement of hydrogen, or carburetted hydrogen, an evolution that actually takes place at times in the dung process, and converts oxide of lead, on the external surface of the pots, to a metallic state. But we cannot suppose the quantity of these gases to be great, since the above result is only observed at intervals, when the process is not altogether successful. Now, as we know that a subcarbonated oxide of lead may be formed by the simple action of air and water or steam, which is the first step in Mr. Richards' process, and since we know that these bodies must be present, to a certain extent, in all methods for manufacturing white lead, we need not resort to acetic acid alone for the requisite oxygen, as is frequently done in the theories that have been advanced on this subject. Nor can we suppose, with any more reason, that carbonic acid arises from the vinegar alone, or in great quantity, and we have moreover abundant evidence to show the necessity of introducing carbonic acid generated from some other source. We are farther aware, from experience, that carbonic acid, air and water, will produce white lead, but that the combination of acetic acid with the water expedites the operation, with the production of a much superior article. From these premises, therefore, we draw the conclusion that the lead becomes oxidized chiefly from air and water, and only in part from the vinegar; that it then combines with free carbonic acid; and that the water, or its vapour, acts in part by keeping the substance formed in a softer state, thereby forwarding action on the remainder. But we may farther ascribe another and important action to the vinegar, by supposing it to combine with the oxide of lead, which has arisen in the manner above stated, constituting an acetate of lead, which is simultaneously decomposed by carbonic acid, in a manner similar to the French method of precipitating a subacetate, by passing carbonic acid gas through its solution. It is true, that in this latter case, a subcarbonate is formed from the subacetate, but if a subacetate be formed in the common process, it may be converted into the neutral carbonate, or common white lead, from the excess of carbonic acid present, and the length of time it remains in contact with it in a moist state,—or carbonic acid may have the power of decomposing a neutral acetate at the moment of its formation, thus producing a neutral carbonate. These theoretic views relative to the manufacture of white lead, are offered by the committee, in the hope that they may lead to a closer investigation of the subject, which may result in much practical benefit to the community.

The ordinary process for white lead by means of manure beds, is attended by many disadvantages—the breakage of the pots—the difficulty of setting them well by workmen—the amount of uncorroded lead remaining,—to which we may farther add, the greater or less uncertainty of the amount of heat and of carbonic acid, excepting after lengthened practical experience. The method consists in the evolution of carbonic acid by the putrefactive fermentation of organic matter, and in the simultaneous generation of heat, which vapourises acetic acid and water, and promotes chemical action. Whether it will be superseded by the process for passing these vapours into a chamber heated by steam, must be determined by a comparison of results. The white lead in either case, appears to be of equal quality, and with an increase of twenty-five per cent. on the metallic lead employed. By the dung process, the metallic matter remaining amounts to ten per cent. when well performed, and averages fifteen per cent., excepting the *failings*, which are converted into litharge and red lead. Mr. Richards states that his re-

mainder does not exceed ten per cent. On this subject, however, it may be remarked, that where the lead is well *set* in the common method, it may be corroded to a considerable depth, for the committee have obtained specimens of white lead nearly half an inch in thickness, made by Mr. J. P. Wetherill, by setting a solid pig of lead in the dung bed. The committee have seen a comparative estimate of expenses, which leaves a balance in favour of the newer processes, but they believe that such an estimate cannot determine the relative values of the two, and that the execution of the new method on a large scale can only prove its superiority to that so long employed with success. In fact, Mr. Richards' mode of manufacture differs from the other, not by a difference of principles, but by a novel application of them. It has a decided superiority in point of neatness, and would also have in regard to accuracy, if the relative action of the agents were sufficiently understood, for we may introduce given quantities of each into the lead chamber, and maintain it at a given temperature. Indeed, it is the latter circumstance on which he chiefly relies for successful practice, and in which his process differs from others resembling it in other respects; and the committee deem his arrangement of heating by steam, convenient and manageable, although they are incapable of judging of its expense.

By order of the Committee.

WILLIAM HAMILTON, Actuary.

March 14, 1839.

Report on Ridgway's Improved Transit Theodolite.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an improved Transit Theodolite, invented by Thomas S. Ridgway, jr., of Pottsville, Penn., REPORT:—

That the improvement consists in the addition of two graduated plates, varying in size, to the transit theodolite, which are placed parallel to the line of the axis, and between it and the telescope; the larger plate is permanently attached to the axis, and that portion of its surface which projects beyond the upper and smaller plate, is so attached to the telescope, as to admit (in case of accident) of adjusting the line of collimation at right angles with the horizontal or bearing axis, when zero on the vernier of the upper plate coincides with 90° on the lower. The telescope revolves on an axis passing through the centre of the plates, and of the bearing axis at right angles, confining the parts in their proper position with regard to each other, by means of a tightening screw. By this arrangement, any plane in which the telescope is made to revolve, may be accurately defined at any inclination with the horizon. A screw is placed under the plates, which, by clamping them together, reduces this instrument to the condition of the common theodolite.

Mr. Ridgway states that he has used an instrument of the above construction for upwards of twelve months, and found it to answer the purpose intended. He suggested, as a variation in form, to affix a vertical arc beneath the graduated plates of the original instrument; but the committee think that the awkwardness of the instrument, and the uselessness of the needle when inclined to the horizon, are serious objections to this arrangement.

The great utility of this improvement is principally confined to mining

operations, more particularly in tracing inclined coal strata; to effect this, the course and inclination, or dip, of a vein, is first taken by means of a drift or gaugeway; the instrument is then placed on the outcrop of the vein, and set to this course and inclination. The telescope being placed in the direction of the stratum, any angle may be taken by means of the additional plates, thus pointing out the crop in elevation or depression, without resorting to the usual tedious method of calculations from levels.

It was suggested, that no means being supplied for readjusting the parallism of the plates with the line of collimation, would be an objection to the instrument, but when it is considered that a slight variation in the adjustment would not materially affect the correctness of the observation, and also, that any accident to the plate would equally require the skill of the workman to repair it, as if it had occurred to any other part of the instrument, the committee are of opinion that the weight of that objection will be removed.

All the adjustments of the common transit theodolite can be made with equal ease and certainty on this instrument by use of the screw before mentioned attached to the plate.

The committee consider this instrument as well calculated for the purpose intended, and a decided improvement of the methods at present adopted to obtain the same results. The principle of the improvement is, that whereas the common instrument, in revolving, describes a cone, of which the bearing point of the telescope is the apex, it is now made to revolve in the plane of its inclination, whatever that may be.

By order of the Committee.

WILLIAM HAMILTON, Actuary.

June 13th, 1839.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1838,

With Remarks and Exemplifications by the Editor.

1. For an improvement in the *Calico Printing Machine*; Alden Sibley, Pawtucket, Bristol county, Massachusetts, July 9.

This patent describes and represents the particular arrangement of the furnishing roll, the colour box, the doctor, and the parts appended thereto, and claims this peculiar arrangement; the object and advantages are not distinctly set forth.

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2. For an improvement in the manner of constructing *Steam Engines;* Nathaniel Bosworth, city of Philadelphia, July 9.

The patentee says: "my first improvement consists in the manner in which I construct and set the boiler, or boilers, and connect them with the pipes for the conveyance of steam, and the auxiliary parts of the engine. The boilers which I employ are of the cylindrical kind, and they are to be so set that they may be completely surrounded by the flame and heated air from the fire, and have their whole surface, therefore, converted into a fire surface, instead of exposing one-half only of the boiler to the direct action of heat, as is usually the case. These boilers, as they are to be entirely surrounded by the fire, are to be kept completely full of water, and are not subject, therefore, to burn out. They are to be so set as to form a consid-

erable angle with the horizon, rising from their front towards their back ends about one inch in a foot, by which elevation the steam will be caused to escape readily from the boiler into the steam chamber, or receiver, at its upper end." The particular manner of carrying this plan into effect is represented in the drawings.

"The steam cylinder, with its stuffing box, and piston, has nothing in it peculiar, excepting the construction of the piston, which is made of metal, in one piece, and without packing; it may be formed of hard cast iron, or of cast steel, and must be finished perfectly true and smooth. Its diameter is to be such that when its temperature is raised one hundred degrees above that of the cylinder, it will still pass through it readily, but leaving no sensible space between the two. When of the same temperature with the cylinder, it will of course pass through it loosely. Up to a diameter of four inches, I think it best to have the piston perfectly solid; but if above this size, it may be hollow, for the purpose of decreasing its weight.

"Such a piston I have found to work without any apparent friction, beyond that which necessarily exists in the passing of the piston rod through the stuffing box; and the most careful observation leads to the conclusion, that there is not any loss of steam between the piston and the cylinder; and if there is any, it has been practically proved to be so small in quantity as to be more than counterbalanced by the decreased friction, and by the other advantages resulting from the improved construction of the engine."

The valve is constructed with reference to a peculiar proportion of its parts, which is illustrated by a diagram; in its general construction it is nearly like some others; its peculiarities we cannot conveniently discuss in the space allotted to our animadversions. It is calculated to cut off at such part of the stroke as may be required.

To indicate the quantity of water in the boiler, a glass tube is used, as in some other machines, its upper end being connected, by a pipe, with the steam chamber, and its lower end with the lower part of the boiler. It is placed at a distance of six feet from the boiler, and from this circumstance, and the arrangement and construction of the tubes, it will always remain cool, whilst it may be so situated as to secure it from the liability to be broken by accident.

"In my improvements, I have had in view, mainly, to attain a higher degree of speed than has hitherto been thought eligible in the reciprocating engine. I have succeeded, in practice, in working the piston of my engine at a speed of upwards of two thousand feet per minute, and have thus produced effects at least five fold greater than have heretofore been produced by engines of the same weight. I am aware that I cannot claim the increased speed of which my engines admit, in the abstract, but I do claim it in combination with, and as resulting from, the manner in which I have constructed my engines, and especially from the peculiar construction of my piston, which moves, as I verily believe, absolutely without friction.

"I claim, therefore, the general combination and arrangement of the above described engine, taken as a whole, and as distinguished from other engines by appropriate characteristics. I claim the within described mode of constructing and setting cylindrical boilers. I claim the constructing of a metallic piston to move without friction in the manner set forth. I do not claim to be the first to have used a solid metallic piston, but I do claim to be the first who has used it so as to pass through the cylinder without friction, having been the first to ascertain that this might be done without a waste of steam. I claim the manner of constructing and using the re-

ceiver, where two or more boilers are employed, as herein fully made known. I claim the manner in which I have constructed my indicator, and connected and combined the same with the boiler, substantially as described. Lastly, I claim the particular construction of the slide valve for cutting off the steam at any designated part of the stroke of the piston; this result being obtained by the particular proportion of its parts, without any greater complexity of construction than in the ordinary whole stroke valve."

We have made large extracts from the specification of this patent, because there are some things in it which are interesting, and well calculated to arrest attention. Whether the experiments which were instituted on a large scale have been productive of new and useful results, we have not been informed, and are apprehensive, therefore, that such has not been the case.

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3. For an improved *Railway Cooking Stove;* Isaac B. Bucklin, West Troy, Albany county, New York, July 9.

"The stove is so constructed that the part which contains the fuel is movable on rollers, and may be made to slide under that portion of it which contains the oven; thus increasing or decreasing the size of the whole according to the use intended to be made of it."

The oven part of this stove is elevated upon legs, and the part which contains the furnace is made to slide under the oven, being guided upon ways, and moving upon rollers. The top of the furnace part is flat, and may have four boiler holes, all of which may be used when drawn out from under the oven; but when slid in, two of the boiler holes are out of use. The back portion of the top plate, having in it the two boiler holes, slides upon ledges, to adapt it to the flue which surrounds the oven, whether in use for the whole, or a part only, of the boilers. A movable flue, or funnel, fits into the front flue of the oven, its lower edges bearing upon the top plate of the sliding part, to make a close joint, and yet admit of free motion. The claim is to "the manner of combining the furnace, with its boiler holes, constituting, by itself, a complete cooking stove, but without an oven, with the part containing the oven, substantially in the manner and for the purpose above described, including, in this claim, the particular manner of adapting the sliding plate and the movable flue to the purposes they are intended respectively to accomplish."

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4. For *Increasing the strength of Wrought Iron and Steel, and of Articles formed of said Materials;* Walter R. Johnson, city of Philadelphia, July 9.

(The Specification will be published in our next number.)

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5. For *Forming and Stretching Horse Collars;* Henry Barton, West Carlisle, Coshocton county, Ohio, July 9.

Several machines have been patented for the above purpose, and in most instances the patents have been obtained for trifling variations in the stretching apparatus, the same end being attained by them, by different modes. Perhaps that before us may be better than its predecessors, but as but few of our readers will feel interested in discussing this point, we proceed to the next patent.

6. For *Elliptic Steel Springs for Coaches, &c.;* Melzer Tuells, Penn-Yan, Yates county, New York, July 9.

The nature of this improvement is stated to be the making the ends of the springs whole, and not with a joint there, according to the usual manner of making elliptic springs, so as to obtain the power of the springs at the ends. And, for the purpose of giving strength to the springs, one or more leaves are to be added at the ends. The claim is to this mode of construction.

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7. For a *Machine for Boring out the Grooves on the inside of the Flyers of Double Speeders;* James S. Brown, Pawtucket, Bristol county, Rhode Island, July 9.

This is a very ingeniously contrived machine for cutting the cylindrical grooves on the insides of the flyers, which are cast solid. The cutter is a grooved cherry, like that employed for making bullet moulds; and the machine is so constructed as to hold the flyer and carry it regularly against the revolving cutter until the operation is completed. The claim is to "the cutting of the groove by revolving cutters against which the flyer is borne and moved by a revolving shaft, guide groove, pinion, and curved rack, with the respective parts combined and operating together in the manner described."

Such a machine is too complex for clear verbal description; we believe, however, that the one under consideration is as simple as the nature of the duty which it has to perform will admit, and we have no doubt of its perfect efficiency.

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8. For *Cutting the Threads on Wood and other Screws;* James & Thomas Keane, Haverstraw, Rockland county, New York, July 9.

The machinery which forms the subject of this patent is represented in the drawing by twenty-one separate figures, which we cannot analyze. The main feature of novelty is the manner of forming the cutters for making the threads, and this part is in some respects similar to that employed by Mr. Sellick in his screw machine; that is, the cutting is effected by rotary wheels, with the worm, or thread, cut on their peripheries, so as to operate like the milling tool used to ornament turned work on the lathe, or jewellers' settings. These wheels are so constructed as to admit of their being ground when their cutting edges become dull. They are for this purpose, divided so as to form two faces. The claims are to "the mode of forming the rotary chaser wheels, and mounting them on adjustable carriages, and forming the said wheels so that they may be ground or sharpened on the face, so as to maintain a regular and equal cutting edge, as set forth; also the formation of said chaser wheel irrespective of any mode of mounting the same for use; and likewise the several modes of mounting and using said wheels, in combination with other mechanical means and appliances, already well known."

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9. For a *Churn*; Daniel Osgood, jr., Blue Hill, Hancock county, Maine, July 9.

We are told that "this improvement consists in the machinery by which the dasher of the common hand churn is made to move up and down by the gravity of the machine and the cream. It is so constructed that the power in its operation, compared with the common churn, is nearly in proportion

to the power required to draw a pendulum in its lateral motion compared with that of raising its weight."

Two common upright churns are to be placed upon a swinging platform, hung in a frame, and these are to be swung backward and forward by a rod attached to the platform, which is suspended by two side pieces within the stationary frame of the machine, through each of which joint pins pass. The upper ends of these side pieces have teeth on them, which mash into teeth on a separate swing frame which is to work the dashers. There is considerable ingenuity shown in the structure, but we apprehend that the merit of the thing begins and ends there. In the preliminary explanation of the views of the inventor, there is an apparent intention of making gravity counteract itself, a thing which has often been attempted, but not hitherto accomplished.

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10. For an improvement in the construction of *Fire Arms;* Elijah Jaquith, Brattleboro', Wyndham county, Vermont, July 12.

This is another edition of the many chambered fire arms, in which there is a revolving cylinder of chambers, the axes of which are parallel with those of the barrel. The main feature of novelty is in making the axis of this cylinder hollow, and placing it so as to coincide with the sight of the gun, so that aim may be taken through it. The other appendages for revolving and holding the cylinder, &c. &c., do not require any particular notice. Most of the numerous modifications of the many chambered guns which have been patented, are to be learnt only from the files of the patent office, or in the resting, or rusting, places in which those which have been made are already deposited, after what can scarcely be called, even a brief, existence. What is the state of the one which is the subject of this article, we do not know.

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11. For an improvement in *Door Locks;* Daniel Ball, Kingsbury, Washington county, New York, July 12.

This lock is to be made in a manner which is intended to diminish its cost to a mere trifle, as it is proposed to cast the box, the bolt, and most of the parts of which it consists, so as to require no finishing, but to be put together as they are taken from the flask. There are not to be any springs used, the spring bolt being forced forward by a weighted lever.

It is proposed to make the bit of the key to slide back and forth in mortises in its shank, and to cause it to be guided, in its action upon the bolt, by an excentric ward, or wheel, cast upon the lock plate. This construction of the key is claimed; with respect to its novelty we have some doubt, and as regards its utility, our doubts are very strong.

"I claim the use of a sliding bit key to operate by means of eccentric wheels, as described. I likewise claim the causing of the bolt, usually called the spring bolt, to shoot forward without the aid of a spring, by means of a weighted lever, operating by its gravity, whatever shape or form it may be thought proper to give to such a lever."

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12. For an improvement in *Lamps;* John C. Fletcher, Springfield, Clark county, Ohio, July 12.

This patent is taken for an improvement on a lamp formerly patented by Mr. Fletcher; the improvement claimed is in "the construction of a fountain, or reservoir, at the top of the lamp, and the conductor, or conductors, as described."

13. For *Apparatus for Roasting Meat and other Articles;* Samuel Pierce, city of New York, July 12.

This apparatus is denominated the "manifold roaster, or planetarium stove," and the patentee says, "The main object of my improvement is to combine together a number of spits, or jacks, each of which is to sustain a joint of meat, a fowl, or other article to be roasted; and each of which spits is to be suspended by a hook over its appropriate dripping pan, the whole of which spits may be made to revolve simultaneously by wheel work, properly geared, either before an ordinary fire, or more perfectly by being placed around a stove constructed for that purpose; in which latter case the spits not only revolve on their own axes, but have an orbicular revolution round the stove. The effect of the heat is, in either case, to be promoted by means of reflectors. When the planetarium stove is complete, and in operation, its external appearance is that of an ordinary cylindrical stove of large diameter, the external cylinder being a case (usually made double) which surrounds the stove, and which also surrounds the system of spits which revolve round said stove."

"What I claim as my invention, and wish to secure by letters patent, is the construction of a cooking apparatus having any convenient number of spits suspended vertically and made to revolve simultaneously round their own axes and round a common centre, by suitably geared wheels; the whole constructed and operated upon substantially as described. I also claim the giving a simultaneous revolution to a number of such spits, combined with a reflector, placed before an open fire, in the manner or upon the principle herein set forth."

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14. For *Preparing Tannin, and Solutions of Tannin,* from astringent barks; Augustus J. Hayes, Roxbury, Norfolk county, Massachusetts, July 12.

(See Specification.)

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15. For apparatus for "*Floating and Raising Vessels, and other Bodies, in Water;*" Samuel Carson, Great Britain, July 12.

The floating, or raising, of vessels is to be effected by the aid of air-tight bags, which, of course, is not claimed as new, the improvement consisting in a mode of defending those bags from injury, and of advantageously accomplishing some other objects connected with their use, as will be seen by the following quotation:—

"What I claim as my invention, and desire to secure by letters patent, is the forming and applying an envelope for the air tight bags, made of woven fabric of sufficient strength to sustain the same, in the manner described, and, as a substitute for such woven material, in the employment, as set forth, of a series of staves, or narrow boards, or of iron, or other metal, to surround said bags. Secondly, I claim the mode described by me of applying a cover of leather to the air pumps to be employed in inflating the bags, constituting an improved packing for the purposes herein fully shown. Thirdly, I claim the apparatus consisting of the forceps and its appendages, as described, for the lowering down flexible air tight bags, or vessels; which apparatus is so arranged that the forceps may be made to take hold of any part of a cable, and be raised and lowered at pleasure from above."

16. For a *Horse Rake for Raking Hay;* William Buckminster, Framingham, Middlesex county, Massachusetts, July 12.

The patentee calls this a flexible hay rake; it is so called because the piece of timber in which the teeth are set has a hinge, or other joint, in its middle. Behind this there is to be a flexible or jointed back board, placed horizontally, and from six to ten inches wide. The intention of this arrangement is not set forth, but the claim is to "the joint in the rake, also the back board in combination, both as described."

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17. For an improvement in the mode of *Hanging a Scythe to the Snath*, and of fastening the tholes; Joseph & Erastus S. Clapp, Montague, Franklin county, Massachusetts, July 16.

Although it has been decided that there was novelty sufficient to justify the granting of a patent in the present case, and although we have no doubt that the plan may answer the intention very well, we shall not attempt to describe the "iron boxes aforesaid, made, constructed, and applied as aforesaid," which form the subject matter of the claim.

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18. For an improved *Machine for Shelling Corn*; Joseph W. Webb, Mount Morris, Livingston county, New York, July 16.

In this machine the corn is to be put into a hopper, and to pass thence through four feeding holes between a vertical revolving cylinder set with teeth, and four vertical angular troughs, borne up against the cylinder by means of springs. It is thence to fall upon an endless apron of slats, which carries off the cobs and allows the corn to fall through, and to be acted on by a fan and the other appendages of an ordinary cleaning apparatus; the claim is to this particular construction.

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19. For a *Machine for Planting Corn;* Elisha Bunce, Westford, Middlesex county, Massachusetts, July 16.

This machine for the making of a furrow, and dropping, and covering, seed corn in rows, is, in its general construction, so much like some others, that a general description of it would apply equally well to a number of the members of the same family. The claim is "the combination of the double plough, constructed as described, with the seed roller, coverers, &c., in their combination as described." This is rather a narrow claim, but it is certainly as broad as the invention.

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20. For *Applying, or Adapting, the Coiled, or Spiral, Spring to Carriages*; Joshua Jones, A. M. Eells, and Horace Griswold, Delaware county, New York, July 16.

"A spiral spring, similar in its construction to the main spring of a watch, enclosed in a barrel, or cylinder, of any convenient diameter, i fixed on an axis near the middle of the perch of the carriage. From the periphery of the barrel containing the spring, and from opposite sides thereof, two bands are extended, one passing to the front, and the other towards the rear of the carriage, each of which bands is attached to the ends of a lever passing downwards from a cross piece, or bar, extending across each end of the wagon above the axletree, and parallel with it. At each end of the cross pieces, or bars, is also a shorter lever, or arm, passing towards the middle of the carriage, in a direction at right angles (or nearly so) with the downward lever before mentioned. To these short levers, or arms, the carriage body,

or box, is attached at each corner, by a connecting rod and shackles, or, if thought preferable, by thorough braces."

"On one end of the cylinder containing the spring is placed a ratchet wheel and catch designed for winding up the spring to any degree of tension that may be required for sustaining either a light or heavy burthen."

The claim is to "the combination of the mode of hanging the carriage body, by means of the axles, arms, downward levers, &c., with the spring or springs, constructed and operating substantially as herein described; and also in combination therewith, the mode of regulating the tension of the spring, or springs, as herein described."

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21. For *Facing Stone;* Daniel Bunnel, Xenia, Greene county, Ohio, July 16.

To what special purpose this machine is to be applied we are not told, excepting that it is to be used for facing stones; and this is to be effected by placing a number of stones on the ground, side by side, so as to form a circular horizontal pavement, having in the centre thereof a step to receive the gudgeon of an upright shaft. From this shaft arms are to extend out to a circular rim, of the diameter of the lower bed of stones. Within the spaces between the arms and rim, other stones are to be laid, and upon causing the shaft and its arms to revolve by horse or other power, and supplying water and sand, the facing is to be effected. The claim is to "the manner of constructing a facing wheel, divided by arms and braces into separate compartments for holding and carrying the stones by which the facing is to be effected, substantially as herein set forth."

The foregoing contains all the information afforded by the patentee. The apparatus bears a strong resemblance to such as has been in common use for grinding certain hard substances which are to be reduced to the state of an impalpable powder, and washed over, such as the silicious matter for earthenware, &c., the main difference being that in these the lower bed of stones is contained within a circular curb, which will hold water.

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22. For an improved *Boiler for Steam Engines;* Abram Van Order, Ithaca, Tompkins county, New York, July 17.

This boiler is denominated the "labyrinth steam boiler." Its exterior form is that of a vertical cylinder, or oval, having a door near its lower part, opening into the furnace, or fire chamber. From this proceeds a flat flue, for the passage of the heated air, which flue is coiled round spirally, and terminates in a vertical flue or chimney, which rises from the centre of the boiler. The claim made is to "the forming of the flue in a flattened scroll within the boiler, and combining it with the furnace and the other parts, in the manner set forth.

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23. For a *Door Spring*, for closing doors; William Wilson, Greenfield, Franklin county, Massachusetts, July 17.

An open, coiled, spiral, or helical, spring, of steel wire, is surrounded by a cylindrical case. One end of this spring is sustained against a standard placed upon the door frame, and the other end by a similar standard on the lock rail of the door. One end of the tube containing the spring must be open, that a piston which enters within the coils of the spring, and has a shoulder bearing on its end, may play within it. The rod sustaining the

piston, and a projecting piece on the closed end of its case, must turn on the standards against which they bear.

The claim is to "the application of the spiral spring to the purpose aforesaid, in the manner aforesaid, and the combination of it with the cylinder, piston, rod, and standards, and the mode and manner of attaching it to, and detaching it from, the door."

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24. For a *Machine for Cleaning Wheat and other Grain;* David H. Cole, Portland, Cumberland county, Maine, July 17.

"The nature of my improvement consists in the compactness, combination, and general arrangement of the machinery so that the grain is carried down between two cylinders on a rotary track, or plane, by which circuitous route its stay is prolonged between rough iron, until the smut and other foul matter is broken to dust, and the cleaning accomplished without the loss or waste of grain."

The description of this machine is of considerable length, referring to the respective parts in the drawings, without which their particular form and arrangement cannot be made known. The claim is as follows:

"The particular manner of making and arranging the circular inclined plane between the cylinders, and the manner of carrying the grain downwards on said plane, by the combined power of wind and inclination; and, in connexion with this, the springs made in the circle which admit and discharge the grain; the bevils on the circles and inner cylinder which give the grain a direction from the joints towards the plane above, and the outlet below; the manner of connecting the sieves and fans, resting the arms of the sieve boxes on the shafts of the fans, by which both receive motion from the same pulley."

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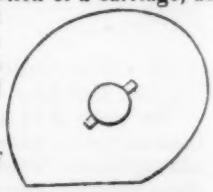
25. For an improvement in *Gun Carriages, for Naval and other Purposes;* William Smith, Washington, Mason county, Kentucky, July 19.

"The distinguishing character of this improvement consists in making about four-fifths of the periphery of each truck, or wheel, of the gun carriage, the figure of a section of a spiral curve, and the other fifth nearly flat, instead of a circle, for the purpose of retarding the motion of a carriage, as the gun recoils at discharging, and thus to prevent the breaking of the breeching, which often takes place when the trunks are made round." The sketch in the margin will give an idea of the intended form of the wheels.



To aid in training the gun for firing forward or abaft, anti-friction rollers are to be placed on the middle of the flat side of the periphery of the wheel, so that it may be moved laterally with but little friction on the deck. The claim is to "the construction of the trucks."

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26. For improvements in the *Plating Mill for Manufacturing Spoons;* Sanford Boon, Hamilton, Madison county, New York, July 19.

The claim made is to "the combination of the skeleton plate, gauge, bar, and rollers, in the manner set forth." Two rollers are to be used for plating, which are barrel shaped, and which are to vary in their diameters, or convexity, as to give the varied thickness required in the different parts of

a spoon, one of these rollers being changed to adapt them to spoons differing in size. The metal is to be passed between these rollers cross-way of the bowl of the spoon, and for this purpose, one of the cheeks of the frame in which they run, called the skeleton plate, has an opening, or long slot in it, for inserting the metal to be rolled. A bar of metal extends along the middle of said slot, or opening, to serve as a gauge or rest bar for the handle part of the spoon to rest on.

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27. For an improvement in manufacturing *Gum Elastic Shoes;* Charles Goodyear, Roxbury, Norfolk county, Massachusetts, July 24. (See specification.)

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28. For *Propelling Boats on Canals, &c., by the action of Air;* James Black, Orangeville, Columbia county, Pennsylvania, July 24.

The claim under this patent is to "the peculiar construction of the tangential outlets in the circumference of the circular case, with the inclined or curved buckets therein, for directing the air put in motion by the revolving fan, and directed towards the stern of the boat, whilst the boat is propelled in a contrary direction to said escape of air."

It would be a total waste of time and types to present our readers with any description of the apparatus here proposed to be employed. The attempt to propel a vessel by forcing air from a fan wheel is too absurd to demand refutation, and would not enter the mind of any one at all acquainted with the mechanics of fluids, excepting such an acquaintance was made in the form of "the baseless fabric of a vision."

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29. For machinery for "*Double Twist Screw Augers;*" Ezra L. Hommedieu & Richard N. Watrous, Chester, Middlesex county, Connecticut, July 24.

"The object of our invention is to form the twist of the auger by machinery applied to that object; and the lip with the centre worm, or pintle, by swaging in dies formed for that purpose." The apparatus, as represented in the drawings, appears to be well adapted to the attainment of the proposed end. The claim affords no information concerning the plan, nor is it one of those things of which a description would be of much general interest.

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30. For an improved *Cooking Stove;* Garret G. Heermance, Poughkeepsie, Dutchess county, New York, July 24.

The claim is to the particular manner in which the oven of this stove is constructed, of which, judging from the model, we entertain a very favourable opinion. The right has passed into the hands of Mr. Jordan L. Mott, stove manufacturer, of New York, and we know that Mr. Mott has made some valuable improvements on it, combining the particular device patented with some others which he intends, at an early day, to make the subject of a patent; and we shall then present it with the engravings necessary to make the construction fully known.

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31. For an improvement in *Pumps;* Jesse Reed, Mansfield, Plymouth county, Massachusetts, July 24.

This may be an improvement in pumps, but we doubt it, although we believe that it possesses some claim to novelty. The chamber and piston or-

dinarily employed are dispensed with, a sort of open vase taking the place of the former, and a hinged lid within said vase performing the office of the latter. This vase part, or open vessel, may be about twelve inches high, and nine inches wide one way, and six inches the other; its outline, as represented, resembles that of an inverted bell. At the lower end of this vessel, there is a valve covering the supply pipe, which descends into the well; and at about one-third of the height of it from the bottom, there is a shutter, or door, called the valve plate, which is hinged to one side of the open vessel, and is leathered on the other three sides to operate as a piston. The brake, or pump handle, is screwed into the valve plate, whence it rises and is recurved over the edge of the vessel; in this valve plate there is a valve opening upwards. This is the whole construction of this pump, so far as novelty is concerned. The patentee observes, that "the facility with which the valves can be taken out, cleaned, and replaced, makes it valuable for vessels at sea."

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32. For apparatus for assisting in the operation of *Catching Fish*; Amrah Tiffany, Gibson, Susquehannah county, Pennsylvania, July 26.

This is an apparatus to be fixed on the rail, or other part, of a fishing vessel, where the lines for letting out and drawing in the seine are to pass over. It is furnished with a friction roller and guides for the lines, and it may be attached by means of two screws, and removed at pleasure. The claim is to the manner of combining the respective parts.

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33. For an improved process for *Manufacturing Sugar from Beets;* Joseph Hurd, jr., Boston, Massachusetts, July 26.

(See Specification.)

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34. For a machine for *Cutting Beet Root* into slices, preparatory to the manufacturing sugar therefrom; Joseph Hurd, jr., Boston, Massachusetts, July 26.

This is a machine in which there are vibrating knives at the bottom of a hopper, so arranged as to cut the roots into thin slices; with these are connected a vibrating bottom, and clearing rods, the action of which is such as to cause the sliced beets, which have a tendency to adhere, to be delivered clear of the cutters, and the other parts of the machine. The description is accompanied by five figures representing the various parts.

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35. For a *Thrashing Machine;* Ammi West, Greene, Kennebec county, Maine, July 26.

The description of this machine for thrashing, includes that of the apparatus by which it is to be turned, in this there are two treadles, upon which the operator is to stand, one foot upon each, and these, by means of ratchets and palls, are to drive the machine. This is rather worse than the ordinary treadmill. To the shaft of this driving apparatus is to be attached a spur wheel, which is to mash into a pinion upon the shaft of the thrashing wheel, which is not in the ordinary cylinder form, but is a flat disk having spring beaters working upon joints near its periphery, and these are to act upon the grain, which is fed to it from a trough standing parallel to the axis of the wheel, the heads of the grain being sustained upon a suitable bed.

Although a full description is given of the propelling apparatus, it has not found its way into, or rather, we suppose, it has been expunged from,

the claim, leaving that to the "attaching the spring beaters on the face, and near the periphery of the wheel to stand alone."

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36. For an improved *Spark Extinguisher;* William S. Montgomery, Baltimore, Maryland, July 28.

The claim is to "the separation of the smoke and sparks by a chambered receiver, into which the smoke and sparks are compelled to pass, and from which the sparks are driven into the ash pan; the whole constructed and operating as described."

To those cognizant of what has been done in the spark arresting way, the foregoing claim will do something more than excite a doubt of the successful operation of the machine. When "the sparks are driven into the ash-pan," there is but little prospect that the smoke and heated air, of which they were the companions, will be separated from them, and driven up the chimney, with unimpaired freedom and velocity. The form of the apparatus before us differs from that of its predecessors; but the principle upon which it is to operate, has been essayed, and has proved a failure in more than one instance.

The patentee states, the manner in which he effects his purpose "is to apply to the front of the engine a receiver equally divided by a partition for two-thirds of its depth, into the smaller chamber of which both smoke and sparks are forced to pass by a curved discharge pipe leading into it from the smoke box of the engine; the sparks being forced, by the exhaust steam, into a pipe that communicates with the ash pan, the smoke rising on the other side of the partition into the chamber of the receiver, and passing off into the chimney."

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37. For an improved mode of *Raising Water;* David L. Myers and Samuel Myers, Christianburg, Montgomery county, Virginia, July 28.

This is a device by which it is intended to raise a part of the water from a spring, or running stream, to such height as may be necessary; effecting this by means of another portion of the water of said stream, or spring. A portion of the running water is to pass along a trough leading into a box at the end of a long lever; the water running into this box forces the lever down, and the other end being connected with the piston of a forcing pump, depresses it; the water is discharged from the box by the descent of the lever, which is then raised by a counter weight, and with it the piston of the pump ascends, and so on alternately.

Devices for the same purpose have been numerous, and some of them on a principle similar to that before us, and, at least, equally good; situations where such a contrivance is applicable are not numerous, and at all events, we much doubt the realizing of a fortune by this patent.

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38. For a machine for *Jointing Staves for Barrels;* James Wyman, Boston, Massachusetts, July 28.

In this machine, the stave is to be held down by clamps upon a suitable bed, and two revolving shafts having an inclination corresponding with the slope of the joint, and carrying cutters like those used in Woodworth's planing machine, are moved along it by means of suitable guides. These shafts are hinged to a step at their lower ends, allowing their upper to recede from or approach towards each other. Their upper portions are acted

upon by guide rails, causing them to open and close so as to form the bilge. The claim is to this arrangement.

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39. For an improved *Water Wheel;* Samuel B. Howd, Geneva, Ontario county, New York, July 28.

This is another of the so-called reacting water wheels; the claim is to "the application of the water upon the outside of the wheel, and operating upon the principle of reaction, by discharging inwardly, with the spouts or shutes, giving the water a direction with the motion of the wheel, applied to a reaction wheel as aforesaid."

This wheel does not contain any thing to take it out of the family to which it belongs, and which, unfortunately, is not one of very high standing, although each of the children has been heralded as a prodigy at the time of its first appearance on the stage.

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent granted to AUGUSTUS A. HAYES, *of Roxbury, in the county of Norfolk, and state of Massachusetts, for a Process of Extracting Tannin from Bark. July 12th,* 1838.

Be it known, that I have invented an improved process for preparing tannin, and solutions of tannin, from astringent barks, for the purpose of tanning hides and skins generally, of which the following is an exact description.

I place in suitable vessels, the contents of which can be heated by steam, or otherwise, the quantity, and kind, of bark to be operated upon, after it has been deprived of its out coat, or *ross*, and add hot or cold water sufficient to cover the bark. I then dissolve so much of the alkaline salts of either ammonia, potash, soda, or lithia, or of these alkalies in a pure state, as may be required to neutralize four-fifths of the acid naturally contained in these barks, (which quantity varies according to the season of cutting the barks) in one barrel of hot or cold water, and mix the alkaline solution so obtained, with the bark and water, by strong agitation. I allow this mixture to remain one hour, and after that time, heat the whole to nearly the boiling point of water, then withdraw the heating source, and allow the clear liquor to drain from the bark. I wash the bark which remains with the weak liquors which have been used for washing other portions of bark, and mix the liquor which drains from the bark with that previously obtained, so long as it is denser than water; what remains is used for washing the next quantity of bark. If I operate without applying heat to the mixture, I allow it to remain for twenty-four hours mixed, instead of one hour, and then proceed as above described.

The solution of oak or hemlock tannin thus obtained, may be used for tanning operations generally, or for concentration, by which the watery part is dissipated by heat, and the bulk and weight greatly reduced.

If I operate on 128 cubic feet, or 1122 lbs. avoirdupois, of dry hemlock bark, deprived of its outer coat, or ross, I use, and prefer, 11 lbs. of dry carbonate of soda, (called soda ash) or 16 lbs. of carbonate of potash, (called pearlash) although the alkaline bases of these salts, and other alkalies in equivalent proportions, will serve for neutralizing four-fifths of the acid naturally contained in that bark, and these are the mean quantities required. I then extract the tanning principle by the method described above, and if

it is to be carried to distant parts, I concentrate it by boiling it in vessels of lead, tin, or copper, heated below 300° Fahr., until it is reduced to the form of a consistent paste.

I claim as my own unaided invention, the process above set forth, by which the alkalies, ammonia, soda, potash, and lithia, or the alkaline salts of these bases, are used for neutralizing the acids existing in astringent barks, and extracting, by their means, the tanning principle, in a state better fitted for use than by any other known process.

AUGUSTUS A. HAYES.

Specification of a Patent for an Improvement in the Manufacture of Gum Elastic Shoes. Granted to CHARLES GOODYEAR, *Roxbury, Norfolk county, Massachusetts, July 24th,* 1838.

The gum, having been dissolved or not, is, as is usual for other purposes, formed into thin sheets, varying in thickness, as may be required for various kinds of shoes. Two sheets, of about an equal thickness and dimensions, are used for a shoe. The last on which the shoe is to be formed, is first covered with one of these sheets of gum cloth, cut in pieces; tape, thread, or other fibrous substances, which have been previously covered with a solution of gum elastic, are placed across the bottom, extending about half an inch up the sides of the shoe, as also at the toe and heel. These stays of any fibrous substance, are intended to strengthen, and also to prevent the shoe from cutting through upon the bottom and sides. They may be placed, or woven, at suitable distances from each other, say about half an inch, in various patterns, according to the fancy of the maker, and being disconnected, do not prevent the shoe from being sufficiently elastic; a heel piece is next placed to stiffen it, and the other sheet of gum, which forms the outside of the shoe, is then placed over the whole upon the last; the sole of the shoe is next added.

All the parts being in an adhesive state when used, are joined together. An elastic binding, formed of gum elastic and thread, or other fibrous substance, is then placed around the top, to prevent the shoe from tearing.

These shoes are afterwards tanned, or cured, according to a chemical process, as specified and patented by myself, the 17th day of June, 1837. These shoes, so constructed and tanned, as hereinbefore described, are preferable to the imported article, inasmuch as they are made to fit exactly, are not liable to damage or tear, and do not sweat the feet, as do other gum elastic shoes.

What I claim as my improvement, and desire to secure by letters patent, is the combination, in the manner above described, of gum elastic and any suitable fibrous substance, so arranged that the shoe may be strong, not liable to damage, and yet elastic and comfortable.

CHARLES GOODYEAR.

Specification of a Patent for Manufacturing Sugar from Beets. Granted to JOSEPH HURD, JR., *of the city of Boston, July 26th,* 1838.

To all whom it may concern: Be it known, that I, Joseph Hurd, jr., of Boston, in the state of Massachusetts, have invented an improved mode of manufacturing sugar from beets, by which the process is so much facilitated as to enable every cultivator to perform it in his own family, with great

economy and efficiency; the apparatus employed not being costly in the first instance, and the operation being carried on, principally, by means of such utensils as every farmer already possesses.

The beets, after being taken from the ground, and freed from all extraneous matter, are to be cut into slices, the thickness of which should not much exceed the eighth of an inch. I have invented a machine for the purpose of performing this operation, which is more effective than any other with which I am acquainted, and for which I have obtained letters patent of the United States. The beets are to be taken out of the ground as soon as they are perfectly matured, and are to be then stored in a cellar, or other suitable place, as otherwise they rapidly undergo a change unfavourable to the production of sugar; they are to remain in this situation until the arrival of the time for slicing and drying them. The proper period for this operation is the earliest season of frost; as, in my process, they are to be exposed to a freezing temperature, so as to freeze and dry them in the air immediately after they are cut. This freezing is an essential point in my process; this, together with the dispensing with the use of lime, and the producing of sugar without molasses, may be denominated its characteristic features. To dry the beets after slicing them, they may be spread out upon laths, or upon netting, or in any other manner in which they will be most completely exposed to the frost, and to the wind; the desiccation, when sliced as above directed, requires but a short space of time, and is effected without injury to the saccharine principle. After being thus frozen and dried, the subsequent steps of the process may be performed at any time, as not the slightest injury will result from keeping the beets in a dry state for any length of time.

When it is desired to proceed to obtain the sugar from the beets immediately, they may be subjected to the freezing process only, then thawed, and submitted to pressure; they will then readily yield the greater part of their juice, which they would not have done if pressed prior to their being frozen. The pressed slices, with the residuum of the sugar contained in them, may afterwards be dried, and kept as food for cattle.

When the sugar is to be extracted from the dried beets, which may be done at any season, they are to be steeped in pure water, which will take up all the soluble matter, an effect consequent upon the change produced in the beet by freezing. The quantity of water need only be such as shall suffice to cover the beets, and may be about one-half of that which was lost in the process of drying. The soluble materials consist principally of the sugar, the mucilage, and a portion of colouring matter. To free the sugar from the mucilage and colouring matter, I generally acidulate the water before pouring it upon the dried beets, by adding to it a minute portion of sulphuric acid; the quantity of this cannot be easily designated, otherwise than by observing that it shall be no greater than shall suffice to render the acid taste just perceptible. Sometimes I add the water alone, and after allowing a sufficient length of time for it to take up all the soluble matter, which may be from three to four hours when cold water is used, but a much shorter period will suffice with hot water; I drain off, and press out the solution from the residual matter, and then add thereto the sulphuric acid, as before directed. In the former mode, but little of the mucilage and colouring matter is taken into solution; in the latter, they are precipitated, or so far disengaged from their combination with the sugar, that they separate in the form of scum, and are readily removed when the liquid is boiled.

The liquid thus prepared, is to be put into a boiler, and placed over a

fire, a portion of the white of eggs, or other fining, being added. When brought to a boiling heat, a scum will rise, which is to be removed after damping, or taking the kettle from, the fire, which is to be repeated as long as any scum rises.

The next operation is to filter the liquor through animal charcoal, (ivory or bone black.) A stratum of two or three inches in thickness will suffice for every useful purpose, when the previous preparation has been used as above directed. The sirop will come through perfectly fine, and nearly as colourless as water; there will, however, be a very slight yellowish green tinge, resulting, apparently, from the presence of a peculiar principle in the beet; this material separates when crystallization takes place; although its quantity is minute, and its weight scarcely appreciable, it will, if left among the crystals, occasion an adhesiveness of the particles, and a tendency to deliquescence; it should therefore be got rid of, and this is easily effected. All that is necessary is to pour a quantity of white sirop upon the crystallized sugar after it has been pressed, so as to moisten it throughout, and then press it again. This operation requires but little time, and should be repeated until the sugar is fit to pack.

The evaporating of the water from the sugar, preparatory to its crystallization, may be in great part performed over an open fire without danger of injury; it may be completed by placing the evaporating pan in a vessel of water kept at about 150° of Fahrenheit's thermometer. When this is performed early in the season, or by taking beets which have been frozen and dried at the proper time, there will not be the smallest portion of molasses produced, the whole of the sugar being crystalizable. In very cold weather, a large part of the water may be removed in the form of ice, by allowing it to freeze, and much labour and fuel be thus saved.

When the clarified sirop is sufficiently concentrated, small brilliant crystals will appear upon the sides and bottom of the vessel, and a crust soon forms over the surface of the liquor; the crystals go on increasing in size, and that portion of the sirop from which the air is excluded continues in a perfectly clear and liquid state; but if the sirop be at this time stirred, it becomes opaque, and of milky whiteness; a deposition of fine white sugar then takes place, and whatever of impurity may have remained in the liquor will rise to the surface; this portion crystallizes more slowly than the other, but by drawing it off, and again exposing it to heat, it will readily form good sugar.

Having thus fully described the process which I have devised for the manufacturing of beet sugar, I do hereby declare, that what I claim as my invention, and desire to secure by letters patent, is the preparing of the beets for the subsequent steps of the process, by exposing them, in thin slices, to the action of frost, after which they may be directly thawed, and submitted to pressure; or they may be dried by a current of cold air, and treated in the manner set forth, at any convenient time; it being always observed, that when the process for the extraction of the sugar is commenced, it must be completed without delay, as upon this depends the ability to produce the sugar without molasses, and without the employment of lime to correct acidity.

JOSEPH HURD, JR.

ENGLISH PATENTS.

Specification of a Patent granted to Thomas Hancock, *of the county of Middlesex, Patent Waterproof Cloth Manufacturer, for Improvements in the Method of Manufacturing or Preparing Caoutchouc, either alone or in combination with other Substances.*—Sealed January 23, 1838.

My improvements in the method of manufacturing caoutchouc consist in forming this substance into sheets, and into long uniform slips or threads, in the manner following:—I prepare the caoutchouc for forming these sheets in the manner fully described in the specification of a patent granted to me for an improvement or improvements in the process of rendering cloth and other fabrics partially, or entirely, impervious to air and water, by means of caoutchouc or India rubber, bearing date the 18th day of April, 1837, and to that specification I refer for the particulars of such process.

I will now describe the manner in which I form this prepared caoutchouc into sheets. I take linen, silk, cotton, or other suitable cloth, and saturate or fill the texture with common glue, size, gum, paste, or any other similar substance easily removable by water, and when dry, I pass this cloth through a calender, or otherwise smooth the surface of it more or less, as the case may require. I then spread the prepared caoutchouc upon this cloth, by means of a machine similar to that described in my said former specification, as suitable for this purpose. If one coating is not sufficient, I repeat the operation, and when the coating is dry, I immerse the whole in moderately warm water, and let it remain until the gum, or size, is sufficiently softened to allow the caoutchouc to be separated from the cloth. If the sheets are required of greater thickness than can be conveniently made by successive coatings upon one cloth, I spread the caoutchouc upon two cloths, and unite the two coated sides together before they are quite dry, and I then strip off the cloth from one side, and apply a third coating, which has been spread upon prepared cloth, in the manner before described, on that side, and continue to add fresh coatings in the same manner, until the required thickness is obtained. Instead of filling the cloth with gum, or size, one side of it may be covered with paper pasted on, and caoutchouc spread upon it, and the cloth and sheet separated by immersion in water as before stated. If it is desired to attach the sheets permanently to cloth leather, &c., I spread a coating or two of the well known common solution of caoutchouc upon it by way of cement, and when nearly dry, unite the sheets thereto by pressure, and then strip off the gummed cloth by immersion in water, as before described. Any suitable pattern, or graining, may be given to the sheets of caoutchouc by raising figures previously on the prepared cloth, either by embossing or otherwise. Colouring matter may be added to the caoutchouc in the manner described in the aforesaid specification, or the sheets may be coloured by laying on, with a brush, any of the common pigments, such as flake white, vermillion, lamp black, blue verditer, &c., mixed with a very thin solution of caoutchouc, composed of about ten ounces of manufactured caoutchouc to one gallon of rectified coal oil, or turpentine. The sheets may be printed with the same colours, by means of plates, type, blocks, or stencilling, in the manner commonly practised. I also form sheets to be used as tablets for writing or drawing on, with crayons, French chalk, &c., by adding pumice powder, fine emery, or other similar gritty substances, either in the manner described in my said former speci-

fication, with reference to colouring matters during the preparation of the caoutchouc, or by coatings of these substances mixed with a thin solution of caoutchouc after the sheets are made, as before described. I also form sheets from the original native and liquid caoutchouc, as imported from South America, by preparing the cloth with gum, or size, as before stated, and I find a convenient mode of doing this is, by attaching two of the gummed cloths together, by means of paste, or gum, and then immersing the cloths in the liquid caoutchouc, and allowing the superfluous liquid to run off. I then hang up the cloth to dry, and when dry, immerse it again in the contrary direction, and again allow it to dry, and continue the operation until the sheet has acquired the desired thickness; I then separate the cloth from it by immersion in water, in the manner before described. The edges must be trimmed, or cut off, if necessary, to allow the water to penetrate into the cloth. The surface of the cloth may be either plain or figured, as before described, and colouring matter, or emery, or pumice powder, introduced into the first or subsequent coatings. If the sheets are required to be only of a comparatively small size, or of particular shapes, I form the flat, or figured, surface upon which I make them, of plaster of Paris, and pour on the liquid caoutchouc. If required of considerable thickness, I find it best to pour on a thin coating first, and allow it to dry, and continue to do so until the desired thickness is obtained. If a very smooth surface is wished, I spread it upon plate glass. In some cases, I employ a raised edge of wood, or other material, as a guide to regulate the required thickness of the sheet, and to prevent the caoutchouc from spreading too far. I also find, for some purposes, that a coating of native liquid caoutchouc improves the sheets formed of manufactured caoutchouc first described; in such cases, I apply it either by dipping the sheets in the liquid, or spreading it on with a spatula, or other convenient instrument. I manufacture the long uniform slips, or threads, from the native liquid caoutchouc, upon cylinders of wood, or metal, by turning, or otherwise forming, a spiral groove, of the width and depth of the required slip, or thread. I fill this groove by immersing the cylinders in the liquid, and, with a straight piece of wood, or metal, clear the liquid from the projecting parts, and when dry, I immerse it again, and continue so to do until the groove is filled, when, by immersing the cylinder for some time in moderately warm water, the slip, or thread, of caoutchouc may be drawn off, and will be of the length and size of the spiral groove. I also follow the same process of coating a plain cylinder with the liquid until a uniform substance of the required thickness is obtained; the cylinder is then put into a machine attached to a screw motion, and the slips, or threads, cut, with a circular knife, to the required size. As this machine is well known to persons conversant with this manufacture, I need not further describe it. And lastly, I do further declare, that I do not, under the said first recited patent, claim as new the processes described by said former specification, nor the mixing of colouring matters with the caoutchouc, nor the common solution of caoutchouc as a cement, nor the use of calenders, or of any other machinery, matters, or things, that have been previously used or practised.

Rep. Pat. Inv.

Specification of a Patent granted to NATHANIEL WORSDELL, *of Liverpool, for Improvements in Apparatus to facilitate the conveyance of Mail Bags, and other Parcels, on Railways or Roads.*—Sealed January 4, 1838.

At present, in taking up or leaving mail bags, or other parcels, conveyed by railway or railroad carriages, it is necessary to stop the train of carriages, or so much to reduce the speed of the train, that the persons at the station may hand up the bags, and that the guard may deposit the bag, or bags, to be left, on the ground, or with a person placed to receive them. And according to both these means, much delay necessarily takes place in the conveyance of mail bags, as well as loss of time to the whole train. And further, when the speed is only reduced, (in place of stopping the whole train of carriages) the bags are liable to be missed by the guard, and such has often been the case, and the bags have fallen to the ground; and in addition to the delay caused by the stopping of the train, and backing the same to the spot where the bag had been left, or otherwise waiting until the same is brought to the train, the bag has, in some instances, been found to be materially injured, and cut, by the wheels passing over it. And from this reason, in case the stations were numerous along a line of railway, which it is very desirable should be the case, in order to give the utmost extent of quick communication, the time lost, even in diminishing speed to take up and put down letter bags, and again to get up the speed of the train, when compared with the whole running time of the train of carriages between two places, would be found to be a most serious loss of time, and will be found to offer almost a barrier to numerous stations being had on a line of railway, or railroad, for mail bags and for parcels. Now, my invention consists in applying mechanical means to railways, or railroads, and the carriages which run thereon, whereby mail bags may be taken and left at any determined places, or stations, with the greatest facility, without stopping or retarding the motion or speed of the train of carriages, and by such means the number of places for taking and leaving mail bags may be increased very materially, and the general system of conveyance of mail bags facilitated. And although I have here spoken of mail bags, I mean it also to apply to bags containing parcels, for it is better to put small parcels in bags.

The principle of action of the apparatus applied is such, that a bag containing letters, or parcels, being held in such a position as to be in the way of suitable means or instruments for taking the bag, and, on the other hand, where it is desirable to leave bags, there is connected with a carriage of the train, suitable apparatus or instruments to support the bag in a position to be intercepted by apparatus or instruments for taking the bag so placed. Now it will be evident that the apparatus in both cases may be varied as to its particular action or formation, to produce the desired effect, and yet remain in substance the same. I do not, therefore, confine my invention to the instruments here shewn, though I believe they are the most simple which can be employed, and the best for the purpose. In my arrangement, a bar is applied at the back of a railway carriage; this bar is capable of sliding to and from the carriage in staples, affixed to the back of the carriage, usually that carriage of a train of railway or railroad carriages called the mail, when the same is intended for mail bags; but it will be evident that the apparatus may be applied to other of the carriages, when intended for the delivery of parcels, and the apparatus for parcels may be separate from the apparatus for mails. A set screw, applied by the guard, (when he has

slided the bar to its position) fixes the bar for the time, till it has taken up or left the bags held thereby. A prong projects from the bar, at right angles thereto, and is curved upwards, in order, when a mail bag has been taken by it, that the same may not fly off by any motion or swing, which may take place by the same being put suddenly into motion with the train of carriages. At each station, or place where it is desired to take or leave mail bags, there is to be an apparatus suitable for holding the bags, to be taken by the train of carriages when passing; and if bags are to be left at the same place, then there is to be fitted up suitable apparatus for receiving the bags which are carried by the bar, on the projecting prongs. The apparatus applied to the railway, or railroads, at the determined stations, or places, is similar to that applied to the railway or railroad carriage, and the apparatus is sustained by a post, or upright, on which may be placed a lamp.

Having thus explained the nature of the apparatus which I prefer for carrying out my invention, and which I have found fully to answer for taking and leaving mail bags and parcels when traveling at high speeds, I will describe the manner of using the same. The guard places the cord, strap, or chain, on to the prongs of the bar, or a number of bags may be strung on to a strap cord, or chain, or other convenient means or instrument, and together securely placed on the prongs; he then slides out the bar, and fastens it by the screw; it will consequently follow, that when the train of carriages passes the station or place where there is a suitable apparatus, the bag, or bags, on the bar will be taken by a prong, or other suitable instrument; and if it be desired that there should be a bag, or bags, taken by the train, as well as left at a station, then such bag, or bags, are to be supported by suitable means, such as the prongs, the post, and the prong of the bar, will take such bag, or bags; and it only remains for me to remark, that I lay no claim to any of the parts separately, nor to their use, for any other purpose than for carrying out my invention, which I declare to consist of the application of mechanical means, such as herein explained, to railways, or railroads, and carriages traveling thereon, for taking and leaving mail bags, and parcels, whereby much time will be saved, and certainty of action obtained, and whereby the conveyance of mail bags, and parcels, will be materially facilitated, as above described. Ibid.

Specification of a Patent granted to Charles Button, and Harrison Grey Dyar, *of the county of Middlesex, for Improvements in the Manufacture of White Lead.*—Sealed December 23, 1837.

We, the said Charles Button, and Harrison Grey Dyar, do hereby declare the nature of our said invention to consist, first, in purifying the gases, or vapours, arising from anthracite coal, or from stone or mineral coal, or from coke, so that either of these kinds of fuel may be used instead of charcoal, in the process of manufacturing carbonate of lead, the said purification being effected by a process of burning and of washing, hereinafter explained.

Secondly, in the use of basic nitrates of lead for producing carbonate of lead; and

Thirdly, in causing white lead to be made from litharge, massicott, or protoxide of lead, by boiling nitrate of lead stirred up with either of those substances, and exposing the mixture, while hot, to be acted upon by carbonic acid gas.

Now, whereas, we do not claim as our invention, or as any part thereof, any particular apparatus for generating carbonic acid gas, nor the particular means hereinbefore described, of introducing the same, when generated, into our solution, although we have shewn the best which we are at present acquainted with, for the purpose of obtaining those two objects; nor do we claim as our invention, or as any part thereof, any particular apparatus as necessary to be used, in order to obtain either the combustion or purification, aforesaid, of the vapours and gases arising from the fuel in the furnace. But we claim as our invention, first, the acting upon the vapours and gases arising from the fuel used in the furnace employed in the process of making white lead, in such manner (by burning and by washing the said vapours and gases in manner hereinbefore described,) whereby we destroy the impurities in the said vapours and gases which are injurious to the colour and quality of white lead, and are enabled to use that cheap kind of fuel, called anthracite, or stone coal, or mineral coal, or coke, in the said furnace, instead of charcoal, and also to use the carbonic acid gas obtained therefrom in the process of manufacturing white lead.

Secondly, the manufacturing white lead from compounds of nitric acid with oxide of lead, in which the quantity of oxide of lead bears a greater ratio to the nitric acid combined therewith, than the oxide of lead bears to the nitric acid in the ordinary nitrate of lead of commerce, and which nitrates we call, and are known by the name of, basic nitrates of lead, in the manner hereinbefore described; and

Thirdly, the making of white lead by uniting and acting upon, or mixing, litharge, massicott, or protoxide of lead, with nitrate of lead, (which uniting, and acting upon, or mixing, are best effected by boiling, as hereinbefore described, but may be obtained at less degree of temperature, though not so advantageously, without boiling,) and submitting the same, so mixed together, to the action of, or bringing the same, so mixed together, minutely into contact with, carbonic acid, in order to produce carbonate of lead, or, as it is usually called, white lead, and in such manner that the same nitrate of lead may be used over and over again many times, with fresh portions of litharge, massicott, or protoxide of lead, as hereinbefore described.

Ibid.

Progress of Practical and Theoretical Mechanics and Chemistry.

A Statistical View of the recent Progress and present Amount of Mining Industry in France; drawn from the Official Reports of the "Direction Générale des Ponts et Chaussées et des Mines." *By* G. R. Porter, Esq., F. R. S.

The law which gives authority to collect statistical details of the mining industry of France, was passed by the legislative chambers in April, 1833. The execution of the duties enjoined by that law, is entrusted to a public department known as the "Direction Générale des Ponts et Chaussées et des Mines," and placed under the ultimate control of the minister of commerce and of public works. Attached to this department is a staff of well instructed, able engineers, who make a personal inspection of every establishment connected with mining operations, and a report is carefully drawn up from materials supplied by these officers, and presented every year to

the minister of public works. These reports present a most elaborate view of every branch of mineral industry in each department of the kingdom; and it may excite surprise on the part of an English audience, to learn that 85 out of the 86 departments into which France is divided, are, in some branch or other, interested in the inquiry; some of them, it is true, are so interested in only a trifling degree; but Gers is the only department which does not, in any way, add to the mineral wealth of France.

In the earlier stage of their labours, the inspecting engineers limited themselves to the collection of information concerning the actual condition of the establishments visited during the current year; but they have since obtained materials for comparing the annual progress of the most important branches, and have compiled and presented tabular statements of the quantity and value of mineral fuel, and of various metals produced in each year, from 1814 to 1836, inclusive. From these tables, the results of which will be given hereafter, it will be seen at what a rapid rate of increase the mineral resources of France have of late years been developed—a rate which may reasonably suggest the probability of its being in some part owing to the public attention having been drawn to the subject, and still more, to suggestions offered to the proprietors of works by accomplished engineers, at times when the works have been inspected. The increase in the value of the coal, iron, lead, antimony, copper, manganese, alum, and sulphate of iron, since the system of inspection was begun, has been from 105,750,995 fr. (£4,230,039,) in 1832, to 154,228,455 fr. (£6,169,138,) in 1836, or 45 per cent., as under,—

	1832.	1836.
	Francs.	Francs.
Coal, lignite, and anthracite	16,079,670	26,607,071
Iron and steel	87,312,994	124,384,616
Silver and lead	856,673	821,534
Antimony	71,233	305,032
Copper	247,680	196,924
Manganese	105,150	152,671
Alum and sulphate of iron	1,077,595	1,760,607
Total	105,750,995	154,228,455

The increase experienced in the same branches during the four years that preceded these inspections, viz. from 1828 to 1832, amounted to no more than 304,392 fr., or £12,175, while the increase experienced during an equal period under the system of inspection, viz. from 1832 to 1836, has been, as above stated, 48,477,460 fr., or £1,939,098.

Coal.—There are 46 coal fields (*bassins houillers*) from which that mineral is obtained in France. These coal fields are situated in the following departments, 30 in number, which are here arranged in the order of their productiveness, as shown by the quantities produced in 1835, and stated in English tons:—

	Tons.		Tons.
Loire	812,914	Haute Loire	28,883
Nord	531,605	Loire Inférieure	21,742
Saône et Loire	142,149	Tarn	18,420
Aveyron	119,152	Hérault	16,201
Gard	45,569	Haute Saône	16,128
Calvados	41,511	Allier	13,826
Nievre	30,162	Maine et Loire	11,556

Puy-de-Dôme	11,387	Vosges	1,356
Rhone	7,463	Dordogne	1,000
Mayenne	6,206	Haut Rhin	537
Ardeche	5,229	Vendée	504
Pas-de-Calais	3,736	Bas Rhin	177
Moselle	3,015	Cantal	177
Correze	1,763	Lot	60
Creuse	1,576	Aude	22

The coal mines in the department of the Loire are the most important, as well on account of the quality of their produce, as of the extent and geographical position of the field. This occupies the entire width of that narrow part of the district of Forez which separates the Loire from the Rhone, where these two rivers approach the nearest to each other. Being thus situated near two navigable rivers, the produce of the mines readily finds its way to Marseilles, Mulhausen, Paris, and Nantes; Lyons is supplied by means of the rail road between that city and St. Etienne. There are 45 separate mining establishments, which extend over an area of 42,038 English acres.

In the department du Nord, coal is raised by eight different establishments, from the coal field of Valenciennes, which is a prolongation of the great coal formation of Belgium. The produce is distributed by the Scheldt, the Scarpe, the canal of St. Quentin, the Oise, and the Seine, and is used in the department du Nord, in the Pas-de-Calais, and in Paris.

The department of the Saone et Loire contains two distinct coal fields. The largest of these (bassin du Creusot et de Blanzy) has 13 mining establishments, over a surface of 77,376 acres: only eight of these establishments were in course of prosecution in 1835. At Creusot, where the pits are deepest, the workings are 650 feet below the surface. A large proportion of the produce is used in the iron works at Creusot; the remainder is distributed, by the canal of the Centre, to the departments of the Upper Saone, and of the Upper and Lower Rhine. The smaller coal field in this department (Saone et Loire) has three mining establishments in operation, extending over 17,560 acres. The produce, which serves for almost all manufacturing purposes, is conveyed by a railway 17 miles long, to the Burgundy Canal, by means of which it is distributed through Alsace, and to the valleys of the Yonne and the Seine.

In Aveyron, there are three coal fields, for working which there are 23 mining establishments. The produce is for the most part used in the manufactories of Decazeville and de la Forezie. If the navigation of the Lot were improved, the coal of Aveyron might readily be conveyed to Bordeaux.

The Bassin d'Alais, in the department du Gard, although occupying a surface of 66,510 acres, and worked at 20 different points, produced in 1835, less than 50,000 tons. Nearly the whole that is raised is used in the iron works in the same district: the quantity is thus limited, because of the deficiency of roads or other means of distribution. A projected railroad, to connect the mines with the Rhone, and the Canal of Languedoc, would give a great impulse to mining industry in this quarter, by conveying the produce to Narbonne, Perpignan, Marseilles, and Toulon, thus rendering it available for steam navigation in the Mediterranean.

The Bassin de Littry, in Calvados, supplies fuel to Bayeux, Vire, and Caen. A part of the produce is used on the spot for lime burning. The first steam engine that was used in France was employed in 1749, to clear these coal pits of water.

The produce raised in the remaining 24 departments is so small that it

would be trifling with the time of the Section to offer any particular account of their mines. A table is subjoined, in which are stated the quantity and value, in English measure and money, of the coal, lignite, and anthracite, respectively, raised in all the departments of France in each year from 1814 to 1836. It will be seen, from this table, that the produce has been increased from 675,747 tons, in 1814, to 2,583,587 tons in 1835, or 282 per cent. If this interval of time is divided into three nearly equal periods, the average annual produce in each period has been as follows:—

7 years—1814 to 1820, 792,496 tons.
8 " 1821 " 1828, 1,197,491 " Increase 51 per cent.
8 " 1829 " 1836, 1,835,831 " " 53 " from 2nd period.

The increase, comparing the 1st and 3rd periods, is 131 per cent.

The whole number of mines in operation in 1836, was:—

Coal	189	employing	19,813 workmen.
Lignite	44	"	1,181 "
Anthracite	25	"	919 "
	258		21,913 "

Great as the increase has been of late years in the produce of the French coal mines, the inspectors give it as their opinion that it is very far from having reached its utmost limit. On the contrary, they predict that this branch of the national industry will shortly exhibit a more rapid progress than any hitherto seen. Large establishments are in the course of formation in the great field of the Loire, as well as in other localities; and it is expected that the opening of cheaper means of communication will give an impulse to coal mining in quarters where it has hitherto been scarcely attempted.

Statement of the Quantity and Value of Coal, Lignite, and Anthracite raised in France, in each year, from 1814 *to* 1836.

	Coal.		Lignite.		Anthracite.		Total.	
Y'rs.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
		£		£		£		£
1814	636,835	261,112	23,086	9,161	5,689	1,824	665,610	272,097
1815	715,276	324,823	23,300	11,608	5,735	1,985	744,311	338,416
1816	764,785	322,648	25,504	11,239	4,723	1,646	795,012	335,533
1817	815,229	342,976	27,340	16,060	4,572	1,579	847,141	360,615
1818	723,471	313,704	29,600	14,562	5,018	2,120	758,089	330,386
1819	761,800	333,518	44,113	11,846	8,037	4,374	813,950	349,738
1820	871,980	370,114	43,977	21,464	7,405	3,827	923,362	395,405
1821	913,213	395,771	39,122	19,344	5,676	2,490	958,011	417,605
1822	950,899	460,842	48,603	21,316	8,220	3,773	1,007,722	425,931
1823	950,642	404,846	49,194	22,399	9,313	4,507	1,009,149	431,752
1824	1,065,016	435,695	41,032	19,897	13,222	6,481	1,119,270	462,073
1825	1,176,538	482,698	59,242	25,008	23,374	9,915	1,259,154	517,621
1826	1,217,963	520,812	68,116	29,201	14,966	5,992	1,301,045	556,005
1827	1,344,432	557,130	57,838	35,214	25,483	12,185	1,427,753	604,529
1828	1,403,239	565,733	64,939	26,764	29,647	14,969	1,497,825	607,466
1829	1,378,136	539,847	59,719	22,747	32,512	16,884	1,470,367	579,478
1830	1,477,513	582,118	64,348	24,600	30,761	16,221	1,572,622	622,939
1831	1,403,124	549,452	52,513	19,723	30,631	16,726	1,486,268	585,901
1832	1,549,636	600,389	69,177	22,314	38,398	20,483	1,657,211	643,186
1833	1,633,776	672,893	58,274	26,160	45,180	25,288	1,737,230	724,341
1834	1,962,085	748,946	86,064	31,166	53,987	30,715	2,102,136	810,827
1835	1,957,022	793,281	101,508	39,433	57,603	32,532	2,116,133	865,246
1836	2,394,299	1,000,018	96,240	36,514	54,296	27,750	2,544,835	1,064,282

In this table, metrical quintals are converted into English tons, at the rate of 10.1465 metrical quintals to a ton, and francs are reduced to sterling money at the exchange of 25 francs per pound sterling: fractions are discarded.

During the years embraced in the foregoing table, the use of coal in France has been increased in a greater degree than the productiveness of the mines, as will be seen from the following statement of the quantity imported for consumption (*commerce special*) in each year from 1815 to 1836:—

	Tons.		Tons.
1815	245,653	1826	495,325
1816	315,815	1827	531,800
1817	235,269	1828	570,010
1818	277,624	1829	539,247
1819	234,102	1830	621,459
1820	276,705	1831	533,259
1821	315,785	1832	567,251
1822	352,192	1833	686,118
1823	321,497	1834	730,281
1824	456,644	1835	755,365
1825	499,325	1836	949,373

The greater importations of the last three years have been encouraged by a partial diminution in the rate of duty on consumption—a measure rendered necessary by the rapid extension of steam navigation. This great invention, which appears to be only now beginning to develope its full energies, will probably soon compel a further relaxation on the part of the French government, and will in various ways cause a great and permanently-extending increase to this most important branch of the mining industry of England.

[TO BE CONTINUED.]

Galvanization of Metals; or Patent Processes for their Protection from Oxidation, by coating or covering them with Zinc.

In our last volume, (p. 122,) we published a general description of the invention of M. Sorel, of a means of preservation of metals from oxidation, by taking advantage of the galvanic or electric action which results from the contact of two metals, relatively negative and positive; also reports of various eminent chemists upon the efficiency of the preservative means. The process was originally patented in France by the inventor, and was brought into public notice by a joint stock company, the shares of which were in great demand, and attained to an enormous premium in the market. In consequence of the favourable reception the invention met with, monopolies were secured in almost every country in Europe, and in America. The British patents were obtained, in the first instance, by communication of the invention to Captain Craufurd, and of the subsequent improvements of M. Sorel, to M. Lecomte de Fontainemoreau. The "British Galvanization of Metals Company" is, we understand, preparing to apply the invention to practice on a most extensive scale; Messrs. Crawshay, and some of the most extensive iron masters in the kingdom, being interested in the business.

In a matter which bids fair to be one of the most important of the age, in connexion with metallurgy, we are happy to be able to lay before our readers full and authentic particulars of the various processes employed—in-

cluding the substance of all the patents which have been obtained, and the most recent improvements in the process.

First;—the mode of preparing the metals, or articles of metal, to be coated or covered with zinc.—The plates, or other articles of metal, are to be cleansed of rust, or other extraneous matters which may be adhering to them, in the following manner: They are to be immersed in a bath of water, acidulated with sulphuric acid, which acidulated water, if used hot, should be used is a leaden vessel, or if used cold, in a wooden vessel. Plates, or sheets, of metal should be placed vertically in the bath. The plates of metal, or articles of metal, are allowed to remain in the acidulated bath till the rust, or other extraneous matter, becomes loose, or easy of being detached; they are then to be taken out and thrown into cold water, from whence each piece, or article, is taken separately, and scoured with fine sand and a piece of cork, or by any other convenient and suitable means; rubbing them occasionally with a brush, as the scouring proceeds, after which they are again thrown into water, to remove the loosened particles of rust or dirt. Small articles, such as nails, hooks, and the like, which cannot be conveniently scoured with sand, need only be washed or rinsed when taken out of the acidulated bath. Another method of cleansing, or preparing, the metals, or articles of metal, is to wash them separately, (except where they are so small that this cannot be done conveniently) either in a solution of sal-ammoniac, or in a bath composed of about equal quantities of water and muriatic acid. In cases where the sulphuric acid bath is used, the metals or articles of metal may remain therein, without injury, for some time; but when the muriatic bath is used, the metals, or articles of metal, should be dried and coated, or covered, with the zinc as quickly as possible, otherwise the metals, or articles of metal, are speedily rusted or oxidized, by the muriatic acid adhering thereto. Where, however, it is not convenient to coat or cover the metals, or articles of metal, immediately after they are taken out of the bath, they may be preserved, temporarily, from rust or oxidation, by depositing them in lime-water, or some other alkaline solution. In all cases, the metals or articles, should, previously to being coated or covered with zinc, be dried, by being held or placed near a fire, or over a reverberatory furnace.

Second;—as to the crucibles, or vessels in which the zinc is to be melted.—The zinc is to be melted in a crucible of earthenware, or in a crucible of iron, or iron vessel similar to those used in tinning sheet iron, lined internally with bricks, connected with potter's clay, or other earthen substances, so as to prevent any contact between the zinc and the iron, which would not only produce an alloy of zinc and iron, but cause the crucible to be destroyed, besides preventing the zinc from adhering to the metals, or articles of metal, desired to be coated or covered. The method which has been found to answer most efficiently in practice is, to melt a considerable quantity of lead in an iron crucible, and to drop upon the melted lead an iron hoop of such diameter as just to fit within the interior of the crucible, so as that a part of the hoop shall be immersed in the lead, and part project above the surface. The zinc is added to the melted lead, and when it is fused, being lighter than lead, and not combining to any material extent therewith, always remains at the surface, and only comes in contact with the inner rim of the iron hoop, plunged in the lead in the crucible. Any opening which there may be between the hoop and the crucible, is stopped up with clay, to prevent any zinc getting between the hoop and the crucible. By these means, the zinc, instead of spoiling or destroying the crucible, only spoils or destroys the hoop,

which can easily be replaced by another, or others, from time to time. Instead of an iron hoop, an earthen one may be used in the same manner as already described of the iron hoop. The best method of heating the crucibles is, to surround them with either coke or charcoal.

Third;—as to plates of metal, or articles of metal of a large size. The zinc being melted in manner before described, must be skimmed carefully, and its surface covered with sal-ammoniac, rosin, borate of soda, black or white, or other flux. The operations of covering, enveloping, or plating, should be performed as soon as may be after the zinc, or alloy of zinc, is in a state of fusion, as at a high temperature it would rapidly volatilize the sal-ammoniac, or other material employed as just described, to cover its surface. The plates or articles of metal having been cleansed, or prepared as before described, are to be taken hold of by means of a pair of tongs or forceps, with very narrow-pointed nippers, in order that as small a mark as possible may be left upon the plates, or articles of metal; they are then inserted in the fused zinc, moved about gently, and drawn out slowly, so as not to take up too much of the zinc, and yet so as that the zinc shall not have time to set, or become hard upon the surface of the plates, or articles of metal, covered. The plates, or articles of metal must then be thrown into clean water, and rubbed therein with a sponge or brush, and afterwards dried by passing them through bran, or saw-dust: without this washing and rubbing, the plates, or articles of metal, would be defaced by black spots. Additional clearness and whiteness may be given to the plates or articles of metal, by dipping them rapidly in water acidulated with sulphuric acid, previously to their being thrown into the clean water. Large plates, or articles of metal, must be introduced very slowly into the fused zinc, because when suddenly plunged in, explosions are apt to take place. Where plates of metal warp or bend in consequence of the heat of the zinc into which they have been dipped, or otherwise, they must be passed between rollers, being first powdered or sprinkled with rosin, sand, or some powder of a nature to prevent slipping, as they pass between the rollers. Plates of about the size of ordinary tin plates may be zinced several at a time, by being placed in a grated case with handles, care being taken to keep the plates apart from one another in the grated case. When chain cables or other large chains are zinced, upon being withdrawn from the crucible they are to be shaken, in order to prevent the links from becoming joined or soldered one to another. Cannon balls and other large articles should be heated in a reverberatory furnace, or otherwise, previous to their being zinced. Where articles have screws, or other parts which do not require to be protected, the said screws and other parts may be covered with a thin coating of clay. Vacant, or cut-out places in articles may be stopped up with wood.

Fourth;—in certain cases it may be found expedient to apply a second coating of tin. For example, in cases of large sheets or pieces of metal which may be placed in contact with substances which might corrode the zinc, or in cases of vessels intended to receive acids, or to be used in the preparation of food, where it is necessary that the zinc coating should be covered with tin, pure tin, or tin mixed with two thirds of lead, is in such cases to be melted in an iron crucible, and covered with a layer of fat or tallow, about two inches thick; the articles having been rubbed with a sponge or brush, moistened with a solution of sal ammoniac or muriatic acid, are to be quickly plunged into the melted tin and drawn out slowly, that the tin may

properly cover the zinc. The melted tin, or melted tin and lead, should be kept at such a heat as almost to inflame the tallow upon the top thereof.

Fifth;—process of covering with zinc small pieces of metal, such as nails, small chains, and the like.—Articles of this description being immersed in the acidulated bath before described, must be moved about so that the acid may act as equally as may be on every part, and so that by the friction of the pieces one against another, the oxide and dirt may be removed. They are then dipped in muriatic acid and dried in a reverberatory furnace, and the coating of zinc given in either of the following modes: the zinc (which should be very pure) being fused in a crucible, (small if of iron, to avoid spoiling any large quantity of zinc), and covered with sal ammoniac or other suitable material, the articles to be coated are thrown therein, and allowed to remain for about one minute. They are then taken out slowly with an iron skimmer, and by small portions at a time, allowing as much as possible of the superfluous zinc to drop off. The articles so taken out of the crucible are, upon cooling, necessarily soldered or attached together by the zinc, of which there is besides a considerable excess attached to them; to free them from all that zinc which is not wanted for the purpose of protection, the articles are put into a reverberatory furnace and covered with charcoal: a red heat is then maintained for about a quarter of an hour, and the combined mass of charcoal and zinced articles is mixed, stirred, and shaken by means of an iron rod or poker, until the excess of zinc has been separated from the articles; being then drawn to the front of the furnace by an iron rake or other means, they are kept in agitation until the zinc or alloy is set. The remainder of the process is the same as in the case of large articles before described. But a still more convenient and efficient process of coating nails and other small articles is that which follows:—the articles are placed in a wire basket, which is plunged in melted zinc, covered with a layer of sal ammoniac or other suitable material; the basket is then drawn out of the fused zinc, and carefully shaken, so that any excess of zinc adhering may fall off; after which it is thrown into water or other fluid, not of a nature to attack the sal ammoniac or other covering material used. It is of importance to seize the proper moment for throwing the articles into the water, but the tact necessary in this respect is probably to be acquired by practice only. A perforated cylinder, or any machine of a similar kind, revolving on its axis, may also be used for finishing the nails and other like articles. As soon as taken out of the melted zinc they should be thrown into the machine then revolving on its axis; and this machine should be kept at a degree of heat sufficient to prevent any superfluous zinc stopping up the holes.

Sixth;—to zinc wire.—The following is the method adopted; the wire having been previously prepared in manner before prescribed, is wound upon a drum or cylinder, and one end of the wire being introduced into the fused zinc, covered with sal ammoniac or other suitable material, it must be made to pass horizontally through it, and maintained in a proper direction, and with a proper degree of motion, by any suitable contrivance, and as it emerges from the zinc bath, it must be rolled upon a second drum or cylinder, and afterwards cleaned and finished in the same manner as recommended for other articles.

Seventh:—process for zincing fire-arms and polished and filed steel articles. The zinc employed for this description of articles must be very pure, and if melted in earthenware crucibles, these crucibles must, where the articles are large, be placed inside other crucibles of wrought iron or cast iron, the

empty space between the earthen and cast iron crucibles being filled up with fine sand or lead; the melted zinc is then covered over with sal ammoniac or other suitable material, as in the other methods; but to prevent the sal ammoniac or other suitable material from staining the articles by adhering to them when they are drawn from the melted zinc, some earthy substances, such as gravel, sand, lime, or chalk, in pieces or powder are mixed therewith. After the articles to be zinced are well covered over with the zincing, they are polished. First, all unevenness in the zinc coating is made to disappear, which is effected by means of files or scrapers; afterwards, pumice stone, sand stone, or emery, or glass paper, is used, and then the polishing is terminated as in the case of any other metals. It is important not to use hard bodies to make the coating smooth and give the polish; cork, leather, rags, or other similar things, should be employed. Without this precaution the zinc might be rubbed off in some places. It is to be observed, that to take the polish well, the articles should not have been polished previously to the zincing.

Eighth;—process of making zinc powder.—The zinc is put into a reverberatory furnace, every opening that would admit the atmosphere being carefully closed, and the temperature of the melted zinc raised to a degree approaching red-heat. The door of the furnace is then opened or lifted, and the zinc skimmed; after which, one-tenth of its weight of wrought (not cast) iron filings moistened with muriatic acid (to which some sal ammoniac may be added) is thrown into the fused metal, it being stirred all the while. After the introduction of the filings, the surface of the zinc must be covered over with fine charcoal powder, and the temperature carried to about the cherry-red heat, at which temperature the zinc must be maintained for about one hour, stirring it occasionally with an iron rod or poker. The metal is then conveyed into a brick, earthen, or cast iron, trough, and covered over with a lid of cast iron to exclude all contact with the atmosphere, and is stirred by means of an iron rod passing through a hole in the cast-iron door or lid, until, by cooling, it becomes so solid, that it can be stirred no longer. When quite cool it is ground into powder, and the more friable it is found to be the better the operation has succeeded. The powder thus obtained will preserve from oxydation copper and iron, polished and filed steel, such as clock work, articles of hardware, ironmongery and the like, by merely covering the articles with the powder, and this, even though they should be exposed to wet or damp.

Ninth;—process of making and applying zinc paint and paste.—The zinc may be also applied through the medium of a paint or paste, in the following manner: The powder of zinc is mixed with any of the unctuous substances generally used in paints and varnishes. The substances which have been found to answer best, are those which partake of the nature of the zinc, that is, are conductors of galvanic fluid, and hence this paint has been commonly called galvanic paint. Very good paint is to be made with oil distilled from the refuse tar of gas manufactories, adding one-third of spirits of turpentine. Oil varnish may also be used, but it is objectionable on account of its high price. Linseed oil may be employed, as it is in common paint, but it is not quite so favourable to the galvanic effect. White lead, or ceruse, may be added to the paint to give it more consistence. The proportions of the materials of the paint depend on the substances with which the zinc powder is mixed, and on the uses to which the paint is to be applied. With the same powder a paste may be made by rubbing copper, steel, and filed or polished iron, with which, they will be effectually pro-

tected. This paste is made with melted wax; into which is put ten times its weight of powder of zinc, and about 1-50th of tallow or oil.

Tenth;—process of making a zinced paper.—For protecting small polished metal articles, a zinced paper, or wrapper, is employed, manufactured by mixing powder of zinc, ground very fine, with the pulp of the paper while making, or by powdering common paper previously covered with some adhesive substance, such as gum, or flour paste, taking care always to exclude the use of animal glue, which has a tendency to cause the iron to rust.

Eleventh and lastly;—process of plating copper, iron, and other metals with zinc.—Solid plates of zinc may be combined with other metals for their protection from oxydation, by plating in the following manner:—The iron, copper, or other metal, being previously cleansed by the acidulated bath, in the manner before described, it is covered with thin sheet zinc, well powdered with sal ammoniac, and the two sheets of metal are passed through heated rollers, from which they are received into water in a state of perfect adherence.

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On Caoutchouc. By Andrew Ure, M. D., F. R. S., &c. &c.

(to the editor of the london journal of arts.)

Sir,—Since writing the article Caoutchouc for my "Dictionary of Arts, Manufactures, and Mines," now in course of publication, I have received, from several quarters, some valuable information; and have also made a series of experiments upon the subject, the results of which I have now the pleasure of transmitting to you for insertion in your journal.

Hitherto the greater part of the caoutchouc has been imported into Europe from South America, and the best from Para; but of late years a considerable quantity has been brought from Java, Penang, Sincapore, and Assam. About twelve months ago, Mr. William Griffith published an interesting report upon the *Ficus-elastica*, the caoutchouc tree of Assam, which he drew up at the request of Captain Jenkins, agent in that country to the Governor-General of India. This remarkable species of fig tree is either solitary, or in twofold or threefold groups. It is larger and more umbrageous than any of the other trees in the extensive forest where it abounds, and may be distinguished from the other trees, at a distance of several miles, by the picturesque appearance produced by its dense, huge, and lofty crown. The main trunk of one was carefully measured, and was found to have a circumference of no less than 74 feet; while the girth of the main trunk, along with the supports immediately round it, was 120 feet. The area covered by the expanded branches had a circumference of 610 feet. The height of the central tree was 100 feet.

It has been estimated, after an accurate survey, that there are 43,240 such noble trees within a length of 30 miles, and breadth of 8 miles of forest near Ferozepoor, in the district of Chárdwár, in Assam.

Lieutenant Veitch has since discovered that the *Ficus-elastica* is equally abundant in the district of Naudwar. Its geographical range in Assam seems to be between 25 deg. 10 min. and 27 deg. 20 min. of north latitude, and between 90 deg. 40 min. and 95 deg. 30 min. of east longitude. It occurs on the slopes of the hills, up to an elevation of probably 22,500 feet. This tree is of the banyan tribe, famed for "its pillared shade, where daughters grow about the mother tree," which has furnished the motto *tot*

rami quot arbores, to the Royal Asiatic Society. Species of this genus afford grateful shade, however, in the tropical regions of America, as well as Asia.

Many species of other trees yield a milky, tenacious juice, of which birdlime has been frequently made; as *Artocarpus integrifolia*, and *Lakoocha*, *Ficus indica* and *religiosa*, also *F. Tsiela*, *Roxburghii*, *glomerata*, and *oppositifolia*. From some of these an inferior kind of caoutchouc has been obtained.

The juice of the Ficus-elastica of Chárdwár is better when drawn from the old than from the young trees; and richer in the cold season than in the hot. It is extracted by making incisions a foot apart, across the bark down to the wood, all round the trunk, and also the large branches, up to the very top of the tree; the quantity which exudes increasing with the height of the incision. The bleeding may be safely repeated once every fortnight. The fluid, as fresh drawn, is nearly of the consistence of cream, and pure white. Somewhat more than half a *maund* (42 libs.) is reckoned to be the average produce of each bleeding of one tree; or 20,000 trees will yield about 12,000 maunds of juice; which is composed in 10 parts, of from 4 to 6 parts of water, and, of course, from 6 to 4 parts of caoutchouc. The bleeding should be confined to the cold months, so as not to interfere with, or obstruct, the vigorous vegetation of the tree in the hot months.

Mr. Griffith says, that the richest juice is obtained from transverse incisions made into the wood of the larger reflex roots, which are half exposed above ground, and that it proceeds from the bark alone. Beneath the line of incision, the natives of Assam scoop out a hole in the earth, in which they place a leaf of the *Phrynium capitatum*, Lin., rudely folded up into the shape of a cup. He observes that the various species of *Tetranthera*, upon which the *Moonga* silk worm feeds, as also the castor oil plant, which is the chief food of the Eria silk worm, do not afford a milky caoutchouc juice. Hence it would appear that Dr. Royle's notion of caoutchouc forming a necessary ingredient in the food of silk worms, and being "in some way employed in giving tenacity to their silk," seems to be unfounded. If Botany discountenances this idea, Chemistry would seem to scout it altogether, for silk contains 11.33 per cent. of azote, and caoutchouc contains none at all;* being simply a solid hydro-carburet, and, therefore, widely dissimilar in constitution to silk, which consists of oxygen 34.04, azote, 11.33, carbon 50.69, and hydrogen 3.94 in 100 parts.

This hydro-carburet emulsion is of common occurrence in the ORDERS *Euphorbiacia* and *Tulicea*, which may be looked on as the main sources of caoutchouc. The American caoutchouc is said to be furnished by the *Siphonia elastica*, or the *Hevea guianensis* of Aublet, a tree which grows in Brazil, and also in Surinam.

Dr. Royle sent models of cylinders, of $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in diameter, and 4 or 5 inches in length, to both the Asiatic and Agricultural Societies of Bengal, to serve as patterns for the natives to mould their caoutchouc by. Mr. Griffith says that this plan of forming the caoutchouc into tumblers or bottles, as recommended by the committee of the London Joint-stock Caoutchouc Company is, in his opinion, the worst that can possibly be offered; being tedious, laborious, causing the caoutchouc to be blackened in the drying, and not obviating the viscidity of the juice when it is exposed to the

* See my paper on the ultimate analysis of vegetable and animal substances, in the Phil. Trans. for 1822.

sun. He recommends, as a far better mode of treating the juice, to work it up with the hands, to blanch it in water, and then subject it to pressure. I shall presently describe a still better method which has recently occurred to me, in experimenting upon the caoutchouc juice. This fluid, with certain precautions, chiefly exclusion from air, and much warmth, may be kept in the state of a creamy emulsion for a very long time.

New Experimental Researches of Caoutchouc.

The specific gravity of the best compact *Para* caoutchouc, taken in dilute alcohol, is	0.941567
The specific gravity of the best Assam is	0.942972
" " Sincapore . . .	0.936650
" " Penang	0.919178

In the process of making the ELASTIC TISSUES,* the threads of caoutchouc are first of all deprived of their elasticity, to prepare them for receiving a sheath upon the braiding machine. For this purpose they are stretched by hand, in the act of winding upon the reel, to 7 or 8 times their natural length, and left two or three weeks in that state of tension upon the reels. Thread thus *inelasticated* has a specific gravity of no less than 0.948732; but when it has its elasticity restored, and its length reduced to its pristine state, by rubbing between the warm palms of the hands, the specific gravity of the same piece of thread is reduced to 0.925939. This phenomenon is akin to that exhibited in the process of wire-drawing, where the iron or brass gets condensed, hard, and brittle; while it disengages much heat: which the caoutchouc thread also does in a degree intolerable to unpractised fingers, as I have experienced.

Having been favoured by Mr. Sievier, managing director of the Joint Stock Caoutchouc Company, and by Mr. Beale, engineer, with two different samples of caoutchouc juice, I have subjected each to chemical examination.

That of Mr. Sievier is greyish brown, that of Mr. Beale is of a milky grey colour; the deviation from whiteness in each case being due to the presence of aloetic matter, which accompanies the caoutchouc in the secretion by the tree. The former is of the consistence of thin cream, has a specific gravity of 1.04125, and yields, by exposure upon a porcelain capsule, in a thin layer, for a few days, or by boiling, for a few minutes, with a little water, 20 per cent. of solid caoutchouc. The latter, though it has the consistence of pretty rich cream, has a specific gravity of only 1,0175. It yields no less than 37 per cent. of white, solid, and very elastic caoutchouc.

It is interesting to observe how readily and compactly the separate little cloths or threads of caoutchouc coalesce into one spongy mass in the progress of the ebullition, particularly if the emulsive mixture be stirred; but the addition of water is necessary to prevent the coagulated caoutchouc from sticking to the sides or bottom of the vessel and becoming burnt. In order to convert the spongy mass thus formed into good caoutchouc, nothing more is requisite than to expose it to moderate pressure between the folds of a towel. By this process the whole of the aloetic extract, and other vegetable matters, which concrete into the substance of the balls and junks of caoutchouc prepared in Assam and Java, and contaminate it, are entirely

* See "Dictionary of Arts, Manufactures, and Mines."

separated, and an article nearly white and inodorous is obtained. Some of the cakes of American Caoutchouc exhale when cut the fœtor of rotten cheese; a smell which adheres to the threads made of it, after every process of purification.

In the interior of many of the balls which come from both the Brazils and East Indies, spots are frequently found of a viscid, tarry-looking matter, which, when exposed to the air, acts in some manner as a ferment, and decomposes the whole mass into a soft substance, which is good for nothing. Were the plan of boiling the fresh juice along with its own bulk of water, or a little more, adopted, a much purer article would be obtained, and with incomparably less trouble and delay, than has been hitherto brought into the market.

I find that neither of the above two samples of caoutchouc juice affords any appearance of coagulum when mixed in any proportions with alcohol of 0.825 specific gravity; and, therefore, I infer that albumen is not a necessary constituent of the juice, as Mr. Faraday inferred from his experiments published in the 21st vol. of the Journal of the Royal Institution.

The odour of Mr. Sievier's sample is slightly acescent, that of Mr. Beale's, which is by far the richer and purer, has no disagreeable smell whatever. The taste of the latter is at first bland and very slight, but eventually very bitter, from the aloetic impression upon the tongue. The taste of the former is bitter from the first, in consequence of the great excess of aloes which it contains. When the brown solution which remains in the capsule, after the caoutchouc has been separated in a spongy state by ebullition, from 100 grains of the richer juice, is passed through a filter and evaporated, it leaves 4 grains of concrete aloes.

Both of these emulsive juices mix readily with water, alcohol, and pyroxilic spirit, though they do not become at all clearer; they will not mix with *caoutchoucine* (the distilled spirit of caoutchouc), or with petroleum-naphtha, but remain at the bottom of these liquids as distinct as mercury does from water. Soda caustic lye does not dissolve the juice; nitric acid (double aquafortis) converts it into a red curdy magma. The filtered aloetic liquid is not affected by the nitrates of baryta and silver; it affords with oxalate of ammonia minute traces of lime.

In a continuation of this paper I shall lay before your readers, next month, several interesting facts concerning the manufacture of caoutchouc on the great scale, supplementary to the account given in my Dictionary of Arts, &c. Jour. Arts and Sciences.

February 18, 1839.

Hydrostatic Weighing Machine. *By* Captain Ericsson.

The object of this invention is that of dispensing with the use of weights, in all ordinary weighing in which ounces are not counted. The principal features are:

1. That the instrument is not subject to any friction; hence, that its accuracy is not, like the balance, affected under heavy weights.
2. That the motion of the parts is almost imperceptible, wear and tear being thereby prevented.
3. That the weight may be read off the moment the article is suspended.
4. That by suspending the instrument in the ordinary hoisting tackles,

the precise weight of goods, &c. may be obtained by the very process of loading or unloading.

The annexed drawing, represents a section of the model.

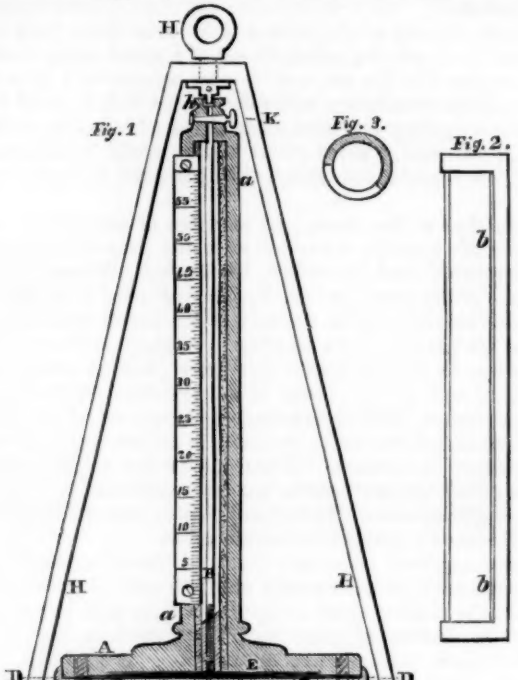

Fig. 1. A is a shallow inverted box of cast iron, with a hollow stem *a*, *a*; into this stem is inserted a glass tube B, bedded in plaster of Paris. C is a plate of cast-iron with a wide recess in it, firmly secured to the box A, a piece of India rubber cloth D, D, being inserted between them, so as to form a tight joint. E is a small quantity of mercury contained in the box A, and resting on the India rubber cloth D, D; this being supported by, and fixed to, a plate or piston F. This plate rests on, and is firmly attached by a screw to, the under cross-bar G; and this bar is suspended by two rods H, H, and the swivel eye-bolt H, which is partly inserted into, and made to slide in, the stem *a*, *a*, at *h*. I is a loop fixed to the bottom of the plate C, without touching the cross-bar G; it has a hook J correctly under the centre, to which hook the article to be weighed is suspended. K is a small stop-cock, which may be shut whenever the instrument is not in use; it will prevent any mercury from escaping when moving the instrument, or should it chance to be placed in a horizontal position.

Rather more than one quarter of the circumference of the stem *a*, *a*, is cut away, to show the tube, and let the rise of the mercury be seen, the index-plate is screwed to one side of the opening. Though the glass tube is protected by nearly three-quarters of the stem *a*, yet a further security is provided for it when out of use. A tube like fig. 2, and 3 its section, is slid over the stem before the index-plate is screwed on: this slides round one way, to show the glass tube through its side-opening, and back again, till its margin *b*, *b*, comes against the index-plate, and shuts the glass tube quite up.

The plate F, with the mercury on it, is supported by the rods and eye-bolt, H. The weights of the stem, *a*, *a*, with all its parts, the plates A and C, the loop and hook, I, J, are always floating on the mercury; which, in consequence, rises in the tube to balance them. From this surface the number on the index begins. All articles to be weighed are, through the hook J, supported from the plate A, which causes it to press so much more on the mercury, and drive it up the tube enough to balance the weight appended.

It may be convenient to place two adjusting, or safety screws L, L, in the bar G, the upper ends of which shall stand high enough to prevent the plate *c* from descending so low as to spill the mercury over the top of the tube B, should any article be hung on whose weight exceeded the range of the instrument.

The limit of the power of the instrument for weighing will depend on the diameter of the piston and box, and the length of the glass tube; thus, for instance, a piston and box of about 16 inches in diameter, with a tube of 3 feet, would weigh above 3600 lbs. It is worthy of notice, that the greatest motion of the piston in an instrument of this size will only amount to $\frac{1}{600}$th of an inch.

The effect of changes in the temperature will, evidently, be an increase or diminution of the specific gravity of the mercury: this will, however, not affect the accuracy of the indication, for, though the mercury dilates more than the materials of which the box and piston are composed, still it can only affect the indication in a direct proportion to its expansibility; whereas the dilatation of the box and piston will counteract in proportion to the square of their expansibility. A slight error in the indication still remains, which will be completely corrected by fixing the index-plate at its lower end only, allowing the top free motion during changes of temperature. Regarding the construction of this instrument, it is of importance to make the bore of the glass tube, in all cases, $\frac{3}{16}$th of an inch, and the space between the circumference of the piston and the box should never exceed that dimension, however large the instrument may be. Trans. Soc. Encour. Arts.

A Resonant Spring for Table Clocks. *By* Henry Mapple.

It is common in table-clocks, in order to get a deeper sound than is given by such bells as can conveniently be attached to them, to substitute for a bell a resonant spiral steel spring, which, when well made, will give a deep-toned, musical vibration when struck. In the French clocks the resonant spring is thin, and is fixed to the case by the centre or inner end, the case itself being made of maple, or some light wood. The sound given by the spring under these circumstances is very good, but such cases are liable to split in tropical climates. A considerable demand for such clocks exists in

our colonies; and, in order to prevent the cases from splitting, English clockmakers generally have them made of mahogany or rosewood. The resonant wire is also thicker than that used by the French clockmakers, and is usually fixed by the outer end of the coil to the back plate, but the sound is rarely very good; the vibration, in the opinion of Mr. Mapple, being injured by a want of solidity and firmness in the part to which the spring is fixed. Mr. Mapple uses a solid block of iron, of the weight of about eight pounds, to which he attaches the spring by means of two screws, so as to make the contact between the block and the spring as complete and immovable as possible: the block itself is placed on the seat-board of the case. The form of the block he does not consider as of any great importance, for he has made the same weight into the form of a thick pillar, and found it to answer very well. A certain proportion, however, must be preserved between the spring and the mass of the weight; for, when this latter is very large, the sound is more or less absorbed; that is, a spring vibrating with a certain degree of power, is capable of putting into effective vibration only a certain mass of metal. Ibid.

The Tides.

In a Lecture on the tides, delivered at the Bristol Institution, at the request of the President and other members, by the Rev. W. Whewell, of Cambridge, it is stated that the complete formation of the science of the tides is a process which is not yet finished, but is now going on. It would be a great mistake to suppose that the labours which the entire application of the doctrine of universal gravitation requires are already terminated. In the case of the tides there remains much to do, and much in which many persons who feel an interest in the progress of science, may take a part. The inhabitants of Bristol have the means of contributing in a very eminent degree, to this object;—they have, indeed, already done much towards it. By the liberality of some of the public bodies of this city, a self-registering tide-machine has already been erected at the Hotwells. This machine is constructed by Mr. Bunt, and is incomparably the most accurate and complete of any that has yet been employed; an account of this machine has been read before the Royal Society of London, and is now in the course of being printed; and the sheets on which this machine records the time and height of every tide (some of which were exhibited) contains by far the best materials for future tide researches which have ever been produced. It would be a very great loss to science that these observations should not be continued, and the inferences drawn from them, which they are capable of furnishing. To do them justice, these observations ought to be treated in the same manner in which the astronomical observations of standard observation are treated; that is, they should not only be recorded, but constantly discussed and examined, with a view of obtaining a better knowledge of the rules which they follow, and with the intention of comparing them with theory as far as possible. Many individuals, and many cities, as Edinburgh, York, Glasgow, and Liverpool, have established astronomical observations; but the same expenditure and the same labour, if applied to the tides, would give results of greater value to science, because, in regard to the tides, more remains to be done. To do this in Bristol, would imply a sympathy with the progress of science, and a zeal for its promotion, which would be very suitable and noble accompaniments of the career of com-

mercial prosperity, which, we trust, this city is destined to run. By establishing a permanent tide observatory, with a provision for the regular reduction of the observations, and the consequent constant improvement of tide tables, Bristol would render a greater service to science than any city has ever yet rendered. Naut. Mag.

Of Chemical Combinations, produced in virtue of the presence of Bodies which remain to continue the process. By Mr. Exley.

It has been observed, said Mr. Exley, that in many instances, powerful chemical affinities have been brought into activity by the presence of certain bodies which remain insulated. This Berzelius attributes to a peculiar force, which he calls catalytic force. Several reasons are adduced to show that this catalytic force is but one species of the general effects which occur usually in chemical actions, all of which are modifications of universal gravity arising from circumstances. The actions of this force were illustrated in four instances:—First, said Mr. Exley, a piece of spongy platina, about the size of a pea, is placed before a fine jet of hydrogen: this produces the combination of oxygen and hydrogen, raising the temperature till ignition occurs. To explain this by my general principles, it must be observed that, as in all metals, so especially in platina, because of its great density and atomic weight, the sphere of repulsion is very small. Hence, the ethereal atmospheres of its atoms are very dense, on which account the atoms of other bodies are drawn very nearly into combination, and thus, by its influence, the atoms of oxygen and hydrogen are brought so near together as to effect their union; caloric is given out; this favours the like union of other atoms, till ignition is produced. The effect of a clear surface of platina in causing the combination of a due mixture of oxygen and hydrogen, depends on the same conditions. 2nd, Another example given, was the conversion of starch into sugar, by means of dilute sulphuric acid. 3rd, The conversion of sugar into alcohol. 4th, The conversion of the alcohol into ether, by means by sulphuric acid. Athenæum.

Researches on the Chemical Equivalents of certain Bodies. By Richard Phillips, Esq., F. R. S.

The author examines, by a new series of experiments, the truth of the theory of Dr. Prout and Dr. Thompson, namely, "that all atomic weights are simple multiples of that of hydrogen"—a theory which the late Dr. Turner had maintained is at variance with the most exact analytic researches, and, consequently, untenable. Although the experiments of Dr. Turner, and the inferences which he drew from them, agree very nearly with those of Berzelius, it still appeared to the author desirable to investigate this subject; and it occurred to him, that the inquiry could be conducted in a mode not liable to some of the objections which might be urged against the processes usually employed. Dr. Turner, having adopted a whole number, namely, 108, as the equivalent of silver, this substance was selected by the author as the basis of his inquiry into the equivalent numbers of chlorine, and some other elementary gases. It appeared to him, that the chance of error arising from the fusing of the chloride of silver might be entirely removed, and other advantages gained, by experimenting on silver on a large

scale, with such proportions of the substances employed as were deemed to be equivalents, and instead of calculating from the whole product of the fused chloride, to do it merely from the weight of such small portion only as might arise from the difference between theoretical views and experimental results. The author concludes, from the train of reasoning he applies to the series of experiments so undertaken, that no material, and even scarcely any appreciable, error can arise, from considering the equivalent numbers of hydrogen, oxygen, azote, and chlorine, as being 1, 8, 14, and 36 respectively. Ibid.

The New Waterproof Clothing.

In the variable climate of England, it has long been a great desideratum to obtain an effectual means of rendering clothing impervious to rain, without impeding the free escape of perspiration. This important object has at length been most completely attained by an invaluable discovery first publicly introduced by Mr. Walter Berdoe, tailor, 69, Cornhill, and now coming into general use. In consequence of its having hitherto been viewed as an utter impossibility for a garment to resist water, yet to admit air, this discovery will by many be viewed with mistrust; but as seeing is believing, those who doubt are invited to do as we have done, examine and judge for themselves; the result will amply repay them for their time and trouble. We were shown a great variety of samples of all kinds of cloths, gambroons, camlets, merinos, doe-skins, &c., containing water, and having retained it from one to three months, without the least appearance of even dampness on the underside. Boiling water may be poured on the surface of the material, when the steam will pass through while the water is retained. The breath will also freely pass through perfectly unrestricted, as may be seen against a mirror. Such results must at once remove all doubts as to the efficiency of the waterproof, as well as its entire freedom from what is so justly objected to in the unsightly and unhealthy Macintosh, namely, its being air-tight, and consequently preventing the escape of the insensible perspiration. Farm. Mag.

On the Employment of Polarized Light, for the purpose of showing the differences of Isomeric Combinations. By M. Biot.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

M. Berzelius having just addressed a learned letter to the Academy, announcing the extension of the characters of Isomerism to a great number of organic products, I thought I might usefully seize the present occasion to propose to chemists the use of optical processes, as a fit means of aiding them frequently in the study of these bodies, by furnishing sensible indications of their real molecular constitution, both in their isolated states and in the compounds, which they form, without having to fear, in either of these conditions, any chance of decomposition resulting from the means made use of.

The bodies called isomeric furnish the most singular case of chemical mechanism. Containing the same ponderable principles, united in the same proportions, they present, nevertheless, affinities, or at least certain chemical affections dissimilar to each other, which obliges us to regard them as

distinct molecular systems. These two results, apparently contrary, are easily reconciled if we imagine that in these bodies the complete groups which exert chemical action without disunion, contain different numbers of similar atoms formed by the union of their elementary principles; or that these atoms, in equal number, are arranged differently among themselves; or, lastly, that both these kinds of dissemblance take place at the same time. The idea thus formed of Isomerism is even the necessary expression of it, if ponderable principles alone are concerned in the constitution of bodies. It is, at least, the first and most simple that we can entertain until its insufficiency is proved.

The choice between the several possibilities thence just pointed out, is obtained by comparing the ponderable proportions of each body which unite to other bodies to form compounds of the same order; but it is not always equally easy to produce a manifestation of these relations.

For example, the essential oils of citron and turpentine, brought by successive rectifications to a state of permanent composition, have been recognized by several very able chemists to be exactly isomeric. They are found to consist of hydrogen and carbon united in the common proportion of 23 parts by weight of the first, with 177 of the second. But by combining each with a third body, hydrochloric acid, an essential difference is at once perceived. Each separates at first into two portions, still isomeric, which, uniting with the acid, give two products, one liquid, which has hitherto been but little examined, the other solid, which has been carefully analyzed. Now, in the latter, we find an unequal weight of the two essences united to an equal portion of the acid: the relation is as 1 to 2. Whence we conclude that the molecular group which constitutes the essence of turpentine, and which unites with the acid, contains in complex atoms, formed of hydrogen and carbon, a number double of that which constitutes the essence of lemons. This, however, applies only to the solid portion, which has been analyzed. In decomposing this product we no longer procure the essence, but a liquid isomeric with it, and differing from it in many external, physical characters. We know of no other fixed compound derivable from the two essences; and these are almost the only chemical evidences we have of the diversity of their molecular constitution. Now, the employment of polarized light adds the following; first, in sending a ray of this light through each of the two essences, we immediately perceive that their molecular groups are differently constituted; for they act in contrary modes upon the ray, each in the same manner as its hydrochlorate. And further, to bring the atomic intensity of their action, to a state of equality, requires, very nearly, the ponderable relation (rapport pondéral) of 1 to 2, which was found in the solid chemical compound, as M. Dumas remarked when I presented these comparative experiments to the Academy. The liquid obtained from this compound, when decomposed, may also be studied in the same manner. This I had occasion to do with respect to that from the essence of turpentine; first, on a specimen sent me by M. Dumas, and afterwards on others of perfect transparency, furnished me by M. Oppermann, and which were prepared with the greatest care.

A decided dissemblance with the primitive essence was perceptible in their external characters, though their isomerism still remained the same. May not the views thus obtained, in a direct manner from the constitution of molecular groups, as well of the two essences as of the compounds derived from them, be of some aid to chemistry, in cases where the means o research are so limited?

The utility of such a proof is still more evident when we know no body which forms with isomeric substances compounds of the same order into which their own groups enter in various proportions. Such is the case with tartaric and paratartaric acids. Analysis shows their composition to be identical. Experiment thus far appears to prove that in all their compounds of the same order, with other substances, each exhibits exactly the same proportions. This correspondence extends even into the series of modifications which they undergo when acted upon in the same manner in order to destroy them. Nevertheless, their different modes of crystalizing, especially their unequal solubility when disintegrated—an inequality which extends to several of their salts, is sufficient to prove indubitably that their molecular constitution is different; and these are, I believe, the only characters of dissimilarity by which chemists distinguish them. But dissolve them in water, for the purpose of minute division, and pass a ray of polarized light through the solutions, the diverse constitution of their particles becomes immediately apparent; for tartaric acid acts upon this light with a molecular power, sensible, measurable, and which extends to all the tartrates; while, under the same circumstances, no appreciable action of this kind shows itself either with paratartaric acid, or its salts.

The same method—I would willingly say, the same reagent, makes immediately manifest the diverse constitution of a great number of other isomeric substances. Berzelius now regards as isomeric, cane sugar, gum arabic, inulin, fecula, and dextrine. I need not discuss this opinion of the illustrious chemist. It may be that the analogies of the science which he cultivates dictate these agreements. If they become multiplied, if they are discovered to be essential, it will become more and more probable that bodies are not constituted of ponderable principles alone, or at least that these do not completely determine their properties, and this is a very possible truth. However this may be, the substances just named immediately evince diversities of molecular affections as various as positive when studied by polarized light. Cane sugar and fecula turn the planes of polarization in the same direction towards the right; but the intensity of their action is very different, and it is modified very diversely when the two substances are exposed to chemical agents, which change and transform them into other products. Gum arabic and inulin, dissolved in water, act on the polarized ray in contrary directions from the former. They turn the planes towards the left, and chemical reagents modify this effect very differently. The greater number of their reactions may be rendered, at will, slow or sudden. We may follow their progress through whole years under the combined influence of weather and temperature, or witness their accomplishment in a moment. The products formed have also, in general, very different rotary powers. The progress of their formation is so also, and when it ends in the production of saccharine matters, as is the case with the four substances which I have compared, these sugars show a distinction in molecular form by their rotary action. May not all this afford some assistance to chemistry in studying substances which seem identical in their composition, and of which it may be difficult to form distinct atomic arrangements?

I may be allowed to cite amidon as an example. Berzelius admits the accuracy of M. Payen's analysis of this substance and of dextrine. The commissioners of the Academy gave the same judgment. What do these analyses prove? that when fecula, which is primitively an organized globule of sensible dimensions, has been sufficiently disintegrated to allow its molecular groups to combine chemically with other substances, whatever

may be the degree of attenuation and the nature of the chemical principles or mechanical processes employed to effect it, the groups obtained always show the same elementary composition and capacity of combination, so that their atomic formula is always the same. But polarized light proves precisely the same identity, and M. Payen willingly acknowledges that it was this constant identity which guided and sustained him in his delicate researches.

Shall I venture to say that these indications are in advance of the results of chemistry, and show dissemblances of molecular action in cases of isomerism, to which the science has not yet been applied. There is nothing more rigorously isomeric than an aqueous solution of tartaric acid, brought temporarily to temperatures a few degrees different in close vessels. But polarized light shows that the molecular affections of this solution vary progressively with the degree of the thermometer, and return to the same primitive state when the temperature is lowered to the same degree. Are we not to believe that these variations are accompanied by corresponding chemical changes in the groups, and which would be manifest if we had tests sufficiently delicate to appreciate them?

Finally, to the multiplied examples which might be given of these applications, I will only add that the same mode of observation may often serve to render sensible the temporary modifications which certain substances undergo when they combine with others endowed with a rotary power. M. Peligot may easily prove this, in the different soluble compounds he has formed of different kinds of sugar. Neither will this process be less fit to complete the character of the progressive changes which M. Frémy has effected in tartaric acid, by heat. In general, when we enter somewhat profoundly into the study of bodies, we soon find that they must be subjected to the most varied proof to discover the mysteries of their constitution; and the more different the nature of the processes applied, the more are the characters thus revealed valuable for the purposes of synthesis, on account of the very diverse mechanical conditions under which we may bring them together. Could it have been believed a few years ago, that impressions produced on liquids in motion, by the vibration of a musical instrument, would be the indication most immediately adapted to prove the physical mode by which their flowing is effected?

Ann. de Chem. et de Phys. Sept. 1838.

Progress of Civil Engineering.

The Thames Tunnel.—Copy of Mr. Walker's *Report to the Treasury, on the Works at the Thames Tunnel.*

In consequence of several propositions made to the Lords commissioners of her Majesty's treasury, for further means for continuing and facilitating the work, they directed James Walker, President of the Institution of Civil Engineers, to take into consideration the various papers relative to the late irruption of the river, with the special reports from Mr. Brunel, of the works proposed to be carried on at the tunnel, and to report to the treasury his views and opinions on the eligibility and means of prosecuting the work.

"I gave the subjects, (says the reporter), my immediate attention, and was preparing a report thereon, when on the 2nd November, another (the fourth) irruption of the Thames took place, and on the 6th, when I visited

the works of the tunnel, Mr. Brunel, the engineer, and Mr. Charlier, the secretary, requested a postponement of my report for a short time, until they should complete an expected arrangement with the navigation committee of the river Thames, from which they expected increased facility and security. This request I communicated to Mr. Baring, by letter, on the 9th November.

I have since received Mr. Spearman's letter of the 2nd December, transmitting to me, by command of the lords of the treasury, a copy of a letter from the secretary to the Thames Tunnel Company, dated 15th November, together with a report of Mr. Brunel on the present state of the tunnel, and the best mode of proceeding, and also a plan of the works, with a request that I would communicate to their lordships my opinion upon the several points referred to in the papers, previous to their determining on the proposals and recommendations of the company.

Since receiving the above instructions, Mr. Spearman has stated to me the desire to be, that every point, particularly as respects cost or estimate, which I consider of importance in the general question of the tunnel, should be included in my report, so as to bring the whole fairly under the consideration of their lordships.

That Mr. Brunel's different reports in which the same recommendations are repeated, may be brought to their lordship's recollection, I shall give a short abstract of the main points in the order of date.

In his report of 2nd May, 1837, Mr. Brunel ascribes the difficulties which had retarded the progress of the tunnel for the last five months to the excessive rains of the preceding autumn, liquifying the ground between the ceiling of the shield and the river, and causing it to run into the works; he states that this has been augmented by his being deprived of the pumping-well and drain from Wapping, which is stated to have been originally intended, and to have been considered the most efficient means of drainage, particularly as the dip of the strata is to that side, and that before any satisfactory progress can be calculated on, the proposed pumping-well, with a drain or drift-way, should be made, but that a preferable plan would be to sink the fifty-feet shaft for the foot passengers' descent, which would, he considers, be a better means of drainage, and would give employment to the workmen when not in the shield. The fact of the pumping at the entrance of the London Docks having dried the wells in that neighbourhood, is adduced as a proof that a pumping-engine on the Middlesex side would diminish the land-springs in the tunnel.

Mr. Brunel estimates the expense of the shaft, including the steam-engine, pumps, &c. at 6,844*l.*, and the pumping-well alone, at 2,690*l.*, independent of the drift-way or drain, which he calculates at 4,310*l.*, making together 7,000*l.*, which sum he presumes would be saved by forming the shaft, rather than the well, at the present time, exclusive of keeping the workmen and establishment employed, and thereby reducing the amount which is now charged to the tunnel account. He also mentions the impregnation of the water with sulphurated hydrogen, which has proved very injurious to the health of the workmen, as another reason for making the drift-way, as it would be the most effectual means of drawing it off. The report states, that "the fact of sixteen feet of the tunnel having been completed under the described difficulties, is a proof that it can be accomplished, though, owing to the disadvantages, at an enormous price, and that it never could be intended in the conditions of the treasury that he should be deprived of the means of completing the work at the estimated cost."

Mr. Brunel's report, dated 9th August, 1837, recapitulates the substance of his previous report, and adduces the successful result of pumping-engines and drift-ways erected for the purpose of taking off the land-springs that impeded the formation of the Kilsby tunnel in the line of the Birmingham railway, as a proof of the good effect that would be felt in the works of the Thames tunnel by a pumping-engine on the Middlesex side. He states also, as an argument for the works he proposed in his former report, the importance of giving the disturbed and artificial ground time to consolidate, and now proposes, on the completion of the Middlesex shaft, to commence the tunnel on that side also, with a view to greater expedition and economy, and to keep the full complement of men more regularly employed by having the two ends to work at. This, it is stated, would reduce the cost of conveying the men, materials, and excavation to the shaft on the Surrey side. In this report Mr. Brunel further states, that as soon as the plan he has proposed is in satisfactory operation, the formation of the carriage roads might be commenced simultaneously with the tunnel, and that by the various means he now proposes, a saving might be effected in the time, of four and a half years, which, in my report of April 1837, I considered requisite for the completion of the tunnel and approaches, and that, consequently, there would be an earlier receipt of toll and a saving of current expenses and machinery to the amount of 15,000*l.*, by the works being completed one year and a quarter within the time I had calculated. Various accounts and calculations in proof of his several positions are appended to this report of Mr. Brunel, and an estimate that, to carry on the works as he recommends, the sum of 94,000*l.* will be required during one year from August 1837.

The lords commissioners of Her Majesty's treasury having refused their assent to the tunnel being begun on the Middlesex side, Mr. Brunel in his report, dated 7th September, 1837, repeats the other recommendations of his former reports.

The last report of Mr. Brunel that is referred to me, is dated 15th November, 1837, the fourth irruption of the Thames having taken place on the 2nd of that month. In this report he considers the third irruption (that of the 23d of August) as not having been unfavourable in one point of view, as it would enable substantial ground to be substituted for the loose silth that had worked into the tunnel by the irruption; in proof of which he states that the work done before the third irruption cost 900*l.* per lineal foot, while what was done between the third and fourth irruptions cost only 630*l.* The former recommendations and arguments are repeated, and in addition it is now stated that the fourth or last irruption was caused in a great degree by the part of the tunnel then in progress being under the portion of the river chiefly used for navigation, and that the depth being small, the artificial bed of the river, or roof of the tunnel, was liable to be disturbed by passing vessels. This, Mr. Brunel now proposes to remedy, by deepening a part of the river where the tunnel is formed, moving some of the ships in the tiers near the tunnel from the northern to the southern side of the river, according to a plan which accompanies his report, throwing the space which is required to be kept clear for the navigation from the north side towards the middle of the river, over where the tunnel is formed, so as to leave the space which is in advance of the works free for tunnelling operations, and then substituting a thicker roof of clay and gravel raised above the present level, to which, from the navigation not being then over that part, there would not be the same objection as at present. The thicker roof

Mr. Brunel proposes to make 100 feet in length, or in advance of the shield, and 100 feet on each side of it. He calculates on a great saving in the end from this artificial covering, which he estimates at 1,800*l.*, and ascribes much of the late trouble and expense to the passing ships, and the want of a sufficient thickness in his roof, which the navigation prevented his having.

The reports are drawn up in great detail, and the above abstract is to be considered not as a substitute for them, but only as bringing the leading points to recollection in one view, without the repetitions which the reports themselves, being of different dates, naturally contain.

It is now my duty to state my opinion; which is, to recommend Mr. Brunel's proposal to be adopted, as the most economical and creditable way of executing the works, if it be the determination that the Thames Tunnel (a work which for many years has attracted much of the public attention in this, and still more in other countries, and upon which upwards of 80,000*l.* of public money has been advanced,) shall be completed, without making cost an element in the question. I would then even advise more effectual works in front of the shield than Mr. Brunel's description and estimate of 1,800*l.* contemplates; for if the work is to be considered a national or government work, a repetition of the danger, the late irruptions, and the enormous expense of the work, would be discreditable, and, as it may be, it ought to be prevented. In addition to Mr. Brunel's proposals, I would recommend, after the removal of the clay that has lately been thrown in, and a portion of the silth, that two rows of close whole timber piles should be driven between where the ground begins to rise and the present shield, one row on each side of the line of tunnel, with space between sufficient for the shield to travel, and to as great a depth as they can be conveniently driven, the heads being level with low water. These, with a return of shorter piles at the end, would form a dam against the silth. The piles being driven, I would continue the dredging of the silth in the space enclosed by the piles, and then fill up with clay, gravel, &c., as at present, to a sufficient height, and afterwards give the mass time for consolidation before attempting to advance the shield, which, in my report to the commissioners for the loan of exchequer bills, I stated to be an essential element for success in the undertaking. In the progress he has made through very bad strata, Mr. Brunel has fully tried and proved the great power of his excellent shield; but the strata, rendered worse by the irruptions and the causes assigned by Mr. Brunel, are now too bad for even the shield to overcome. By the substitution of good artificial soil to work through, and keeping the silth, or sand, back by the piles, there would be much less difficulty or danger; and with proper precautions, my decided opinion is, that the tunnel may be completed notwithstanding the late irruptions, and with comparatively little difficulty or risk.

Here the question naturally presents itself, at what cost? and to answer it with the probability of accuracy, is still very difficult.

The amount of the company's capital expended previous to any advance of public money was 180,000*l.*

On the 27th February, 1837, when . . . . . received from the commissioners for the loan of exchequer bills had been expended, I estimated the addition then required to complete, at	64,600
	310,000
Making, exclusive of the company's capital . . .	£374,600

Between the 27th February and the 2nd November, 19,300*l.* have been expended, making 83,900*l.* of public money expended to the 2nd November, but the quantity of work done with the above 19,300*l.* is only 19 feet 6 inches, making, (inclusive of 1,400*l.* for pumping, excavating, and claying, after the third irruption,) nearly 1,000*l.* per foot, which very much exceeds all previous estimates, and proves what I stated in evidence before the select committee of the house of commons, that no prudent man would commit himself to the accuracy of an estimate of this work, while it shows also the impolicy of attempting to drive on the shield through the present bad soil without a sufficient covering, and time for consolidation.

In the present situation I consider that the sum of 150,000*l.* should be taken as the estimate for completing the tunneling; and that the shafts and other works remaining to be done, together with the purchases, should not be estimated under 200,000*l.*, making, with the 84,000*l.* of public money already expended, and the company's capital previously expended, a total of 614,000*l.* for the estimate of the work, or upwards of triple the original estimate, and this is allowing but a moderate sum for contingencies, which have heretofore been very heavy.

I have estimated the great descents at double Mr. Brunel's estimate, and yet I have, from the nature of the work, as much doubt as to the sufficiency of that sum as of any other item in my estimate.

If, however, in place of determining to complete the tunnel without reference to cost, which the foregoing observations suppose, the lords of the treasury resolve, as heretofore, to confine their operations to the advance of the tunnel, so as to remove any doubt of its getting through, before they sanction a further heavy outlay, then, although I agree with Mr. Brunel that the pumping-well or the shaft, with the drift-way, or drain, would lessen the springs, I do not by any means think them so essential to the progress of the work as to agree in recommending their being proceeded in at present. Up to the time of the second irruption, in January 1828, the works were under the uncontrolled management of the directors and engineers, and during that period nothing had been done on the Middlesex side with a view of draining the water from the tunneling, although it had then advanced to the middle of the river, only 155 feet having been done since, but in the report of 1831, the drift-way or adit is proposed and estimated, with the pumping-well, at 6,000*l.* Mr. Brunel informs me that the drainage in the tunnel is now very small, and the short time in which the water after irruptions has been taken out, proves that the present pumping-engine is fully equal to the work.

More rain, by two inches, fell during the last six months of 1836 than of 1835*, an increase, but not such as to cause a very important difference in the workings, which I ascribe almost entirely to the ground towards the Middlesex side being of a looser and more sandy and silthy nature than towards the south side; this, it has always been said by the Trinity officers and others acquainted with that part of the river, would be found to be the case; so that, although the spring-water has been an evil and an hindrance, the Thames water has been another and probably a greater, and is the present enemy, which makes the cases of the London Dock or the Kilsby Tunnel parallel to a certain extent only. It is not in preventing the communi-

* The quantity of rain that fell in the last six months of 1835 (as kept at the Royal Society's rooms) was 10½ inches, and in the corresponding period of 1836 it was 12½ inches. In the same period of 1834, a very dry year, it was only six inches.

cation with the spring, but with the river water, that the artificial roof of clay, &c., has been useful.

I agree that the air for respiration would be improved by the drift-way, and probably the present air-pump, which is worked by the steam engine, rendered unnecessary; but this pump, ingenious as all Mr. Brunel's applications are, appears to completely answer the purpose, and would probably be found quite as effectual in abstracting the sulphurated hydrogen, as a drift-way at the bottom would be.

I cannot agree as to the saving of expense by the shorter distance to the Middlesex shaft; the difference of distance in the present situation of the shield would be only seventy yards, and as an excellent railway is laid, and machinery attached for working it by the steam engine, I am sure that the conveyance of the excavated soil along the bottom of the tunnel to the low ground on the Surrey side must be at least as cheap as to the Middlesex side, where the ground is chiefly covered with buildings, and does not require to be raised, and that, as a passage to and from their work, the workmen would generally prefer the spacious lighted tunnel to a drift-way, until the difference of distance is much greater than at present.

That the well, or shaft, on the Middlesex side would give employment to the miners and other workmen when they cannot be employed in the shield, and thus lessen the amount now charged to the tunnel, I entirely agree; but my opinion at the same time is, that they may be fully employed in securing the ground in advance of the shield, according to Mr. Brunel's plan, or with the additional piling, such as I have suggested. It appears to me that sinking the shaft, driving a drift-way, making a new shield, and proceeding from the Middlesex side, would amount to a committal to go through with the undertaking, and ought not to be begun until that, as a previous question, has been determined.

In stating this, I am in some measure influenced by the opinion that Mr. Brunel's estimate for the works on the Middlesex side is too low. He estimates the pumping-well and drift-way at 7,000*l.*, and the shaft-engine and pumps at 6,844*l.*, and gives a decided preference to the shaft. Now the shaft on the Surrey side is stated in the account to have cost 20,000*l.*, and evidently the drift-way, 4310*l.*, should have been added to the shaft, as to the well-plan. The Middlesex shaft may, and probably will, be less expensive than the Surrey one was; I think it unsafe to trust calculation against experience, so far as to take one-third of the actual of the Surrey, as the estimate for the Middlesex, shaft.

Of the propriety and importance of changing the channel for the passage of vessels, from the part of the river in front of the shield which has yet to be tunneled through, over to the part which is tunneled, and forming a body of compact gravel and clay in front of the shield, in the way Mr. Brunel proposes, to a greater thickness than is now compatible with navigation, there can be no question; and I am glad to learn, by a letter received from Mr. Charlier, that the Navigation Committee have agreed to the proposal, and as Mr. Brunel considers that this will remove much of the cause of the late irruption, by enabling him to have a better covering of clay, and preventing vessels grounding upon the artificial bed, and estimates the necessary work at only 1,800*l.*, I have no hesitation in recommending to the lords of the treasury to sanction it, even with the addition I have proposed, should Mr. Brunel be disposed to adopt it. I think the expense of the piling and clay may be taken at about 10,000*l.*, and I feel assured that, if the completing of the tunneling be the object, this outlay

will be more effectual, and much less in amount, than proceeding with the works on the Middlesex side. From the length of the river proposed to be covered with clay, if done according to Mr. Brunel's plan, being three times greater than with piling suggested by me, I think the difference of expense of the two plans would be small.

Having now given my opinion on the various points that have been referred to me, I would beg to add that, as the Thames Tunnel is Mr. Brunel's work as respects design and responsibility, any measure that may be proposed for executing the work should, in my judgment, have his approval. If that approval is refused, unless the lords of the treasury will consent to works which exceed the amount they have yet thought proper to agree to, almost any course would be better than letting the complaint be repeated, "that the engineer has been deprived of the proper means of completing the work at the estimated cost." (Signed) JAMES WALKER.

December 1837.

Repertory Pat. Inv.

A Summary View of the Progress of Architecture in Britain during the Year 1838; *with some Notices relative to its Advancement in Foreign Countries. By* J. C. LOUDON, F. L. S. &c.

In conformity with the plan first adopted in our Third Volume, we proceed to give a short notice of the progress made in architecture in Britain during the past year (1838); though we fear that our readers will find this notice little more than the echo of our summary for 1837. The truth is, that, in drawing up an article of this kind, there is no medium between seizing on a few leading features, and remarking on them, and recapitulating an immense number of details, already given in the course of the volume for the current year. The latter plan is not consonant with our views of what such an article ought to be; and though, as we have just hinted, it may be difficult to discover any grand architectural feature to characterize 1838, yet we shall proceed with such as we can find; hoping, at all events, that the brevity of our article will be some apology for the absence of higher qualities.

If the existence of a general spirit for architectural improvement can be characterized as an architectural feature, this spirit may be safely affirmed to be on the increase, not only in London, but through all the provinces. In London, there is not a house rebuilt, that is not erected in a superior style to what it was before; and the renovation of all public buildings is, in general, effected in a very superior style. This system of improved renovation was first rendered conspicuous in the public-houses, and it has since been displayed, in a striking manner, by the banks and the insurance offices; and, more or less, by the shops, in all the principal streets. The employment, in Regent Street and Bond Street, of the Louis XIV. style in shop fronts is one of the latest improvements in this department; and, in combination with the immense panes of plate glass now used for shop windows, and accompanied by rich gilding on a pure white ground, it has a striking and most magnificent appearance.

The introduction of Roman cement, about thirty years ago, has been the foundation of much of the improvement which has taken place in the elevations of street architecture. During this year, and the preceding, a new cement for roofs, terraces, and roads, has been introduced, the basis of which is bitumen; but, whether this will lead to any great change, either in buildings, by the introduction of flat roofs, or in streets and roads, by becom-

ing a substitute for either foot or road pavement, remains to be seen. Our opinion of it is, that it promises well; particularly for flat roofs, public foot-paths, and garden walks.

The formation of general cemeteries exterior to towns may certainly be considered a feature which has become prominent during the past year. Besides several in the suburbs of London, and one or more in the larger towns, such as Birmingham, Liverpool, and Manchester, they are beginning to be formed in the secondary towns, such as Nottingham, Brighton, &c. We may remark of these cemeteries, that in no one of them, as far as we have observed or heard, are the grounds laid out in an appropriate manner. They are all arranged in imitation of a modern pleasure-ground; the expression of which cannot be considered as in accordance with that of a place of burial; nor are the windings of the walks favourable for economising the ground, which must necessarily be divided into portions of a rectangular form for the graves. Such, however, is the want of invention in persons who are employed to give plans for laying out grounds, whether of cemeteries or public gardens, that they can only repeat in them the winding walks and scattered groups, which they have learned mechanically to adopt in laying out the lawn and pleasure-grounds of a gentleman's villa.

The most striking architectural erections that have taken place throughout England during the last two years are, unquestionably, those connected with engineering. We allude to the magnificent bridges and viaducts erected along the railways, and the lofty engine chimneys, which, forming handsome columns of from 100 ft. to 300 ft. in height, mark the locality of some stationary engine, of waterworks, or of some manufactory. Brick columns of this sort are to be found in almost every part of the metropolis, and in all the great manufacturing towns of England, as well as in those of Scotland. Formerly, no architectural object was seen to rise above private buildings, except the spires and towers of churches; but now, in many parts of the country, and more especially in the north of England, the grand architectural features, which meet the eye of the traveller in the horizon, are the engine chimneys. Perhaps the very highest that has yet been erected in Britain is that at Carlisle, described at p. 165, of the present volume.* With respect to the bridges and viaducts, they are to be found in numbers on every line of railway. Some of the most remarkable are in the neighbourhood of Newcastle, on the railway leading to Carlisle, of which elsewhere, in this volume, we have given a short notice. Those on the Birmingham Railway are of extraordinary strength and massiveness; while those on the Bristol Railway are remarkable for their lightness and elegance. The former, those on the Birmingham Railway, may be said to be constructed agreeably to the maxims adopted by the late engineers, Rennie and Telford, of "stronger than strong enough;" and the latter, on what may be called the modern, scientific principle of "elegant sufficiency." The most perfect example of this last kind of engineering, which we have seen, is the viaduct over the valley of the Brent, at Hanwell, Middlesex.

In foreign countries, the most striking architectural feature that we are aware of is the Girard College, recently commenced at Philadelphia. It will be an edifice of classical form, of great magnitude, and so massively and solidly constructed, as to be apparently of endless duration. The account of this building, and of Girard, in the present volume, p. 446., will, we think, be found of great interest in a moral, no less than in an architectural, point of view.

* Vide Journ. Frank. Inst., vol. xvii., p. 353.

In railroad engineering, the progress which has been made during this year is great; whether we look to the completion of some lines, such as that between London and Birmingham; the progress making by others, such as those from London to Bristol, and from London to Southampton; or the commencement of some, such as those from London to Brighton, and from London to Dover. Our continental neighbours are making proportionate progress. A railroad from Calais to Paris is in contemplation; and a survey has lately been made for one between Paris and Dieppe, which, when the Brighton rail road is completed, will reduce the time of traveling from London to Paris to one day, instead of three days, and two nights.

The subject of paving streets with asphalte, or cement, has already been alluded to. The substitution of blocks of wood, for blocks of stone, in carriage-ways, which has long been in use to a limited extent, in Russia and in some parts of Germany, and which has recently been tried in New York, is, also, proposed to be tried in London. Wheel-tracks of stone, formed in imitation of tramroads, for facilitating the progress of carriages on common roads, are now being laid down in some places, with a view, it is said, of trying how far locomotive engines on such roads can be brought into competition with rail road carriages.

The architectural literature of the year exhibits, as usual, a considerable number of books, all more or less valuable. Those which we think likely to become standard works are, Hood's *Treatise on Heating by Hot Water*, Britton's *Architectural Dictionary*, Wood's *Treatise on Railroads*, Nicholson's *Treatise on Projection*, and, perhaps, one or two others. The *Civil Engineer and Architect's Journal*, the first number of which was noticed in our preceding volume, p. 578., continues to be carried on with great care and industry, and has deservedly obtained an extensive circulation. Among the books which we have omitted, might, perhaps, have been mentioned Dr. Arnott's *Treatise on Warming and Ventilating;* but, believing that author to have erroneous views of the subject of ventilation, as pointed out in p. 230, of this volume, we cannot give unqualified commendation to his *Treatise.* Dr. Arnott's stove, however, as far as it concerns economy and heat, we consider to be the most perfect apparatus of the kind that has ever been brought into notice.*

* This may be true as it respects Great Britain, but it will not hold good, we are well persuaded, in the United States.

Dr. Arnott's stove, if we may rely on the description given of it in the English journals, consists simply of a grate or chauffer placed in a casement of sheet iron, the gases passing through the several compartments of the casement, and thence into the chimney. The heat which is set free by the combustion, and evolved from the gaseous current will pass into the stove or casement, and radiate through the room. A portion of it, however, must reach the chimney, and warm the column of air contained in its flue, otherwise there will be no draught, and the coal will cease to burn. Now the true principle of economy in all such cases, as it regards fuel, as we apprehend the subject, is to retain all the heat in the room except that portion which is essential to the maintenance of the draught by keeping the flue warm. This can be done only, or mainly, by increasing the convolutions or windings of the gaseous current, or in other words, causing it to pass over a surface sufficiently extended to absorb nearly all its heat. There are many modes of accomplishing this object; and several that are in use in our anthracite stoves are, we think, decidedly preferable to Dr. Arnott's. The plan of Professor Olmsted, for instance, by attaching one or more radiators to the furnace, or fire cylinder, effectually secures the retention of the heat in the room, while it prevents the heated surface from becoming so hot as to carbonize the animal and vegetable particles that are constantly floating in the air, and thus deteriorate its quality. Another material advantage of these radiators is that the

In comparing the present Volume of the *Architectural Magazine* with those which have preceded it, we think we are justified in saying that it is not inferior, either in the excellence of the papers which it contains, or in the variety of subjects which have been discussed in it, or brought into notice. One series of papers, commenced in the last Volume and concluded in the present one, we consider to be of particular value to the young architect. We allude to the Essays on the Poetry of Architecture, by Kata Phusin. These essays will afford little pleasure to the mere builder, or to

cold air which enters the room and passes near the floor to the stove, ascends through the open, central cavity of the radiator, and is diffused in a warm state over the room.

Much has been said recently in the British journals, of Joyce's patent stove, elegant in its appearance, and mysterious in its operation to all that have not been informed of the secret. It may stand anywhere in the room, and is quite unconnected with any chimney, flue, or pipe, and will give out its heat for six hours without any renovation or disturbance. All the gases that arise from the combustion are of course thrown into the room. Of the fact of its containing fire and answering the common heating purpose of a stove there is no dispute; but whether any thing deleterious to health issues from it, is a question on which the Doctors have pointedly disagreed. It appears now from the publication of the patent, that the fuel is prepared charcoal,—"prepared" by wetting or saturating it with carbonate of soda, and reburning or heating it to redness before using it. The alleged advantage of this process is that the carbonic acid proceeding from the combustion of the coal, will be absorbed by the alkali as it is formed, and thus be prevented from escaping into the room. Whether such a consequence does ensue or not is a question of vital importance as respects the safety of the stove. Gay Lussac examined some of Joyce's prepared charcoal and could find little or no difference in the amount of carbonic acid disengaged between this and equal weights of good common charcoal formed from light woods. Moreover, we perceive from the December Number of the London Mechanic's Magazine, that a man who was appointed to watch the operation of a new Joyce's stove placed in the centre aisle of St. Michael's church, London, on the 17th November, between 4 and 5 o'clock in the afternoon, was found between 6 and 7 o'clock next morning lying on his face about a yard and a half from the stove, quite dead. Four surgeons were of opinion that the man died of apoplexy. Others thought he had been suffocated by the noxious gases from the stove.

It is probable that this stove, with its prepared charcoal, may still be extensively called for and used in open rooms during the day, without any immediate, perceptible injury from its gases, and as it is considered to afford the *ne plus ultra* of economy, giving out into the room, absolutely, all the heat that the fuel produces, it will still maintain its claims to the patronage of the public.

By the advertisement of William Harper, the sole proprietor of Joyce's stove, we find that a stove adapted to a room 18 feet square will consume only nine pence worth of fuel per 24 hours. Now let us compare this with Olmsted's stove. From the trials recorded in our journal, Vol. xxi., p. 248, it appears that a ton of anthracite coal would be sufficient for the winter, at an average of the external thermometer of 32°, or a ton and a half when the average was 20°, and this for a room of the same size, viz. 18 feet square. Taking the highest estimate, a ton and a half, and supposing this to cost 10 dollars, (a high price for nut coal in Philadelphia,) if we divide this by 150 days, the quotient is 6⅔ cents, instead of 16⅔ cents, the acknowledged daily expense of Joyce's stove. Hence, if anthracite coal can be obtained in London as cheap as in Philadelphia, (and as it is abundant in Wales, we doubt not that it can) it is obvious that the cost of heating by Olmsted's stove would be less than one third of the vaunted cheapness of Joyce's patent, for the temperature registered in the trials above cited, was 5 or 6° higher than that which Harper's advertisement promises to secure. The anthracite stoves, as well as Joyce's, will, when arranged for the purpose, burn 24 hours without replenishing; but we should not presume to recommend its application apart from the use of a chimney or other outlet for the gases.

We have introduced this note from a belief that the matters which it embraces would not be uninteresting to our readers. G.

the architect who has no principle of guidance but precedent; but for such readers they were never intended. They are addressed to the young and unprejudiced artist; and their great object is to induce him to think and to exercise his reason. The great bane of modern architecture is, the tendency of all architects to be ruled by precedent. The evil is, perhaps, equally great in all arts of long standing, such as those of agriculture, legislature, &c.; and it will be proportionably difficult to root out. One of the first steps to this desirable end will be, a better general education for all young men whatever; and the avoiding, by parents and guardians, of inducing young men to follow any branch of the fine arts which they do not evince a decided taste for before they leave school. At present, young men are articled to an architect much in the same manner as they are apprenticed to any mechanical trade. The question is, not whether they are suited for that profession, but whether the income that profession may be expected to afford is suitable for them. In addition to this, the prejudice in favour of ancient architecture, whether classical or Gothic, must be given up, or, at all events, diminished; and, while all the forms and details left us by those who have gone before are free to be used, the combinations in which they are employed must depend for their beauty and effect on intrinsic properties, and not on their having been used in the same combinations before, or on associations connected with them, whether classical or otherwise, which have no connexion with their present use. One of our correspondents, who is at once an architect in extensive employ, and an excellent writer on his art, observes, p. 498. that one cause of the servile system in modern architecture may be traced to the deference paid to the celebrated *Treatise of Vitruvius*. "Had his [Vitruvius'] MS. been burned," he observes, "before it had been discovered by Poggio, the world would have been no loser; and, certainly, modern architecture would have been a great gainer." There are few architects, we are afraid, who will coincide with our correspondent in this opinion; but we do most heartily. Nevertheless, there are some, we trust, of the rising generation, who are able to free themselves from the trammels and architectural bigotry of Vitruvius and his followers; and it is to such alone that we look forward for any real improvement in architecture as an art of design and taste.

Arch. Mag.

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*Mr. Pritchard's "Microscopic Illustrations."**

The microscope is of about the same antiquity as the telescope; but until within the last twelve years it remained an instrument of comparatively small utility. The achromatic principle which was at once adapted to the telescope with astonishing success, was productive of no such happy results on its first application to the microscope. Swammerdam, Lewenhoek, De Torre, Euler, and others, applied themselves with great industry to the discovery of some means of remedying the defects of spherical and chromatic aberration to which the simple microscope is subject, but missed the way to the object of which they were in search, by assuming it for granted that the smaller the angle of aperture the better. To such an extent was this notion pushed, that Lewenhoek had lenses with a focal length of not more than 1-700th or 1-800th part of an inch. To the acute, lively, and enthusiastic Dr. Goring it was reserved to discover, in 1827, that the road t

* New edition, emended and enlarged. 1838. 248 pp. 8vo., with numerous plate Wittaker & Co.

perfection lay quite in the opposite extreme—that on the number of rays of light which can be collected by the object lens from every point on the surface of the objects examined, depends the efficiency of the microscope. And thus, to use the words of Dr. Brewster, it has "become quite a new instrument; and promises to be the means of disclosing the structure and laws of matter, and of making as important discoveries in the infinitely minute world, as the telescope has done in that which is infinitely distant."

Dr. Goring's ablest fellow-labourer has undoubtedly been Mr. Pritchard, whose numerous contributions to microscopic science, both instrumental and literary, we have, more than once, had occasion to notice with commendation in our pages. The volume now before us is an "emended (Query *a*mended?) and enlarged edition" of a work under the same title, which appeared in 1829, and helped greatly to make the value of Dr. Goring's discovery known to, and duly appreciated by, the scientific public; but it is an edition *so much* amended and improved as to be, in fact, almost an entirely new work.

Fig. 1.

Fig. 2.

As many persons—not unlearned even—have been heard to express themselves at a loss to understand how it is that an increase in the length of aperture is so efficacious, we shall take this opportunity of extracting the very satisfactory statement of *the sufficient reason* here given by Mr. Pritchard:—

"Every one who has considered the subject at all, will understand that by a series of glasses of different media, aberrations, &c. may be corrected, and almost entirely dismissed; but it is not so readily perceived how a compound microscope, having a series of glasses, can, with less illumination, give a brighter and more vivid picture, with more of the detail or minute

structure of an object, than can be obtained with greater illumination, by a single lens. In this particular, however, consists the main advantage of an achromatic.

"Let me premise that, in order to render any object visible, it is necessary that rays of light should proceed from it, either by reflection from its surface, or by transmission through it, to the eye. Again, if the number of rays be insufficient, the object cannot be seen, notwithstanding we employ a microscope for the purpose. Bearing this in mind, I will endeavour to explain how an increase of angular aperture in an object-glass, independent of any increase of its magnifying power, will admit a greater quantity of light from any given point on the surface of an object to pass through the lens, so as to render the structure of the object visible.

"Let A and *a* represent two objects, in all respects alike, and let us employ two microscopes, of equal magnifying powers, for the purpose of viewing them. Suppose that we are going to look at some spot on the surface of A, or *a*, which we will imagine to be a delicate tissue. By a well-known law of light, the rays proceed in right lines, in all directions, from this spot, in the manner shown by the dotted lines in both figures. Suppose B B, and *b b* to be two object-glasses, of equal focal lengths; the former a single lens, of the best construction, such as was used in the old compound microscope, and the latter a lens of the newest form, termed an achromatic. Now, these object-glasses will form their respective images at I, and *i*, and they will be of equal dimensions. But if the number of rays proceeding from A, and falling upon the single lens B B, is not enough, when collected at I, sufficiently to stimulate the eye, any minute pore, striæ, or other marking at A, will not be rendered visible; whilst, from the increase of aperture in the achromatic lens, *b b*, allowing much more light from *a* to fall upon it, and to be transmitted through it and collected at *i*, every marking, &c. at *a*, will be clearly represented at *i*; and the eye, being powerfully acted upon by this increase of light, will become highly sensible of it.

"The angles B A B, and *b a b*, are the angles of aperture of the respective object-glasses; and the quantity of light collected and transmitted by each will be as the squares of B B, and *b b*, the focal lengths being equal. Hence it is that the power of a microscope, or that faculty it possesses to render the structure of an object visible, depends upon the angle of aperture of its object-glass, and not upon its magnifying power alone.

"But it may be supposed, perhaps, from this reasoning, that if we throw a greater quantity of light upon an object, so that more may be collected by the object-glass, we shall be the better able to define its structure; which would probably be the case if the additional light could be thrown only upon those minute parts which we wish to examine, and not upon the whole object. But as we cannot do this—as the increase of illumination cannot be made to increase the *relative proportions* of light which proceed from these minute parts, the intended advantage will not be derived."

Mr. Pritchard mentions a curious "case in point," to show the obstinacy of the ignorance which still prevails, among optical instrument-makers, with respect to the necessity of applying the achromatic principle to the microscope as well as the telescope:—

"I have in my possession, at this moment, a triple object-glass, evidently made in imitation of one of Mr. Tulley's achromatics. In constructing it, however, the optician, a person of great respectability, was so unacquainted with what an achromatic is designed to effect, that he actually placed a stop

behind the lenses; so that, notwithstanding the folal length does not exceed half an inch, an angle of aperture of only 7 degrees is obtained. This object-glass, of course, is inferior to a common lens: and hence has originated the erroneous notion that the introduction of achromatics has been no improvement to microscopes."

Every one who has a taste for microscopic investigation, and is desirous of having the best instruments for the purpose, would do well to apply, in future, to Mr. Pritchard himself,* whose improved microscopes and appendages are even better than his books upon them. It is a fact here worthy of particular record, that the *Microscope-goniometer*, invented by Mr. Pritchard to measure the angle of aperture of microscopic object-glasses, has been found of such universal utility that it has been not only employed for reading off the divisions in the trigonometrical survey of Ireland, now in progress, but has been since used by astronomers for similar purposes, in the microscopes attached to transit circles; the advantage of which is, that observations can be read off much longer in the twilight of an evening without artificial illumination—thus causing less fatigue to the eye than is experienced by looking alternately "at objects illuminated by different coloured lights."

Much stronger proofs, however, of the beneficial effects produced on science in general by the new stride made in microscopic instrumentation through the discovery of Dr. Goring, and its successful applications by Mr. Pritchard, and other less distinguished followers, remain behind.

The following passages from Mr. Pritchard's "Introductory Remarks" to his present volume are extremely striking. They presented much that was new to us; and will be found, we doubt not, to contain much that is equally new to the majority of our readers:—

"The fact is, that since the modern improvements the miscroscope has undergone, it is being brought to the assistance, and is at the present time furthering the progress, of almost every branch of natural science. To the Geologist it may be said to be a new instrument. But what has it not even now effected for him? In his study of organic life and structure, it has unfolded to him the precise characters of divers animals and plants which inhabited and cloathed our earth in ages which have long passed away. Look at the discoveries of Agassiz on the fossil creatures of the deep! By a microscopic investigation of such portions of them as have withstood the destructive power of time, namely, their scaly covering, he has been able so to group and class them, that the characters and habits of the genera belonging to each distinct era are clearly demonstrated. A microscopic examination also of the testaceous remains of sundry Entomostraceans found in slate-clay formations, now elevated much above the level of the sea, prove them to have been at some time or other imbedded in the waters. And the Naturalist may even determine by his inspection of the shell, whether the species were the inhabitants of fresh or of salt water, and consequently whether the strata themselves were the indurated beds of the sea, or of some river or lake.

"The *most perfect* animal remains which the microscope has disclosed to us, are the various loricated Infusoria of the division Bacillaria.† These minute creatures are so inconceivably numerous that they cover many miles of surface with several feet of thickness; as instanced in the polishing-slate

* 162 Fleet Street.

† See Mr. Pritchard's Natural History of Animalcules, p. 59.

and rotten-stone of Bohemia. In Tuscany, whole mountains consist almost entirely of the silicified shells of these creatures; thus combining with each other in infinite numbers, to counterbalance, as it were, their individual minuteness, and to teach the unthinking this useful lesson, that Nature in all her operations, is never employed in vain, and that, what are apparently her most insignificant productions, fall not beneath the notice of the profoundest inquirer after truth.

"To the botanist, the aid of the microscope is indispensible. In the investigation of our fossil-flora, what does it not exhibit to us! How beautiful and delicate is the structure of the envelope of some of the fossil-fruits; those, for instance, of our London clay, when viewed under this instrument; and how important is it, that, by its assistance, we can determine with accuracy the natural orders, genera, and sometimes the very species of the trees and plants of former epochs! How, beyond all question, is now demonstrated the vegetable origin of our coal! Preserved within a bituminous lump of coal, which has been deposited for thousands of years deep in the bowels of the earth, you may discern not only the wooden fibre, its arrangement, and the disposal and form of the medullary rays, but even the most delicate of the vegetable organs, such as the spiral vessels, and the beautiful termination of these vessels! These are as distinctly discoverable as in the finest preparations of a recent plant. And what can be more amusing and instructive than the examination of the silicified woods, when formed into sections no thicker than the paper of a bank-note? Thus rendered pervious to light, the organic structure of the wood becomes plainly distinguishable. And emanating from this, what can be a more interesting subject than the inquiry into the mode in which the silicifying process has been carried on—by which the constituent elements of the inmost and minutest portions are changed—whilst their form and situation and colour remain the same? In investigating also that extinct genus of plants, the Lepidodendra, a similar idea is raised in the mind, as to what must have been the particular state of the earth with respect to atmosphere and temperature at the period of their growth, and what the changes which have since taken place, in order to bring it to its present condition.

"In our physiological inquiries into the animal and vegetable productions of the present time, the assistance of the microscope is essentially requisite. When Dr. Harvey made his grand discovery of the circulation of the blood, and first lectured upon it, in St. Bartholomew's Hospital, in 1619, he was ridiculed, and lost his practice, through maintaining what was then supposed to be so absurd and wild a theory. The idea was suggested to his mind by reflecting on the valves of the heart and veins, which were evidently so planned as to allow a fluid to pass but one way. All the philosophical reasoning, however, of this celebrated man, could not establish, what appears to us so plain a truth, until it was evidenced in the circulation of cold-blooded animals, by means of the microscope, and thus placed beyond a doubt. Discerning, as we can do, the very forms of the globules of that fluid, as they flow through the capillaries from the arteries to the veins, in obedience to the laws impressed upon them by the Almighty Creator—viewing this most sublime phenomenon, by which life itself is diffused throughout, and sustained in every part of the system—who can resist conviction of the great truth?

"Nor is it a matter of less importance in a scientific point of view, or less interesting, that by the same means we can perceive the fibrous structure of the muscles and nerves, the form and arrangement of the canals by

which the internal cavities of the bones are lubricated and nourished, the glandular structure of that beautiful and complex apparatus by which the secretions* are carried on—all, and each of these, requiring but the aid of one of our improved microscopes to render them distinctly visible. Again: how admirably developed, by means of the microscope, are the curious and complex structure of the eyes of insects, the crystalline lenses of those of fish, birds, &c.†, and many of the other parts of the visual organs.‡ The eye—that useful and delightful portion of us which furnishes all the endless variety of objects from which we derive so great enjoyment—resembles, in its peculiar formation and arrangement, an achromatic optical instrument. And if we descend to the lower classes of animals—nay, I would hardly say lower, lest some, perhaps, might imagine that in their small forms they do not evince as much perfection as is discoverable in beings of a higher scale, and have not all the functions which are necessary to life as full in operation as even man himself—if we enter upon an investigation of their minute structures, we can determine absolutely nothing without the microscope; and our knowledge of the very existence of many highly-organized and active creatures is wholly dependent upon it.

"Vegetable organography, upon which the modern botanist depends so much for his systematic arrangement, and with which the student is so greatly interested and amused, owes almost its very existence to the microscope. This observation will be found to apply in an especial manner both to the cellular and vascular tissues of plants. The membraneous cellules of cellular tissue are sometimes not more than 1-1000th of an inch in diameter; and those of the ordinary size are about 1-200th or 1-300th. How, then, is it possible that we could become acquainted with their forms and arrangement, but by the aid of the microscope? And so with respect to vascular tissue: it is absolutely indispensable toward acquiring an accurate knowledge of the structure and forms of these membraneous tubes, and of the spiral or annular fibres which surround them.

"A knowledge of the fructification, if I may so express myself, of that numerous and curious class of plants, the Acrogens, could not be obtained without it; nor could the existence of many of them, such as the Fungi, Lichens, Algæ, and some of the Musci, be proved. By its powers, even the ashes of vegetables may be seen to contain the decisive characteristics of organic structure; and the long-debated question of the antiquarian, as to whether the 'fine linen of Egypt,' in the times of the Pharaohs, were of linen or cotton fibre, seeing the latter is now indigenous to that country, is for ever set at rest.

"In many of the larger portions of plants, such as the cuticle of their leaves, the stomata, &c., which require but a shallow magnifying power to display them, there is as great a difference manifested when these are viewed under an achromatic microscope, or under the old compound, as is perceptible between the most highly-finished miniature, where the most delicate features and even the down on the skin are correctly depicted, and the mere black and white profile, where we see but the rude contour of the face. Surely, then, as works of art merely, instruments which can effect so much as this are justly entitled to a due share of consideration, even from the most refined and polished minds."

* Nouvelles Recherches sur la Structure de la Peau, par M. Breschet.
† Philosophical Transactions, 1833.
‡ See Langenbeck on the Eye.

Again:—

"In the study of crystallography, which science may be said to have been for a long time almost at a stand-still, a very extensive field of research appears to be now opening, by the adaptation of polarized light to a microscopic examination of minute crystals—thus eliciting a great variety of curious and beautiful properties, entirely unknown to the world before. This subject being as yet completely in its infancy, it would be unfair to expect an elucidation of it at the present time. To convey, however, some general idea to the reader, of the additional degree of interest which attaches to the phenomena of crystallization by this happy contrivance, it is only necessary to state, that we have now displayed to us minute crystals, with a brilliancy and richness of colouring that is quite inconceivable. We see the smallest difference in their thickness marked by some exquisite change of colour; whilst the beautiful black cross in the circularly arranged crystals of zanthate of ammonia, and the cross with the coloured rings in the compound of phosphoric acid and borate of soda, &c. &c., excite our admiration beyond all bounds. These newly discovered phenomena, after a patient investigation, may lead to results highly interesting, and of great importance to science." Mec. Mag.

On the Erection of Buildings in Unhealthy Situations.

Those who have studied the nature of soils and situations, with reference to their influence on health, cannot but feel surprised at the building projects which are occasionally made public by architects and building speculators. It would be uncharitable to suppose that these architects and builders are fully aware of the danger, as regards health, of living in such situations as those which they propose to cover with human habitations; and it is clear that the great body of house-renters know very little of what is best for them, in point of situation and soil, or speculative builders would never risk their property in covering such situations with masses of buildings. We have been led to these remarks from having seen a lithographed plan for covering a piece of ground, of about sixty acres, we believe, in extent, between Notting Hill, and Shepherd's Bush, with streets, squares, and crescents, of what we suppose will be reckoned second and third-rate houses. The soil is a strong clay; the situations, for the greater part, quite flat; and the whole is so moist, that three or four years ago, when this ground was proposed to be turned into a cemetery, the wetness of the soil, and the want of drainage, were found to be insuperable objections. But, even supposing that there were sufficient drainage, the lowness of the situation, and the retentive nature of the soil, are such as to render the piece of ground altogether unfit for the erection of human habitations, in our present state of civilization, and comparative delicacy of constitution. We have no hesitation in saying, that there is not a spot in the whole of this sixty acres, on which we should willingly set ourselves down, even if we had the ground and the house-rent free. A respectable builder, we are told, being asked to take a portion of the ground, honestly replied, that he would never undertake to build a house in which he would not be willing to live himself, if necessary. Unfortunately, few architects or builders ever think at all of the healthiness or unhealthiness of the situation of the houses they are employed to build. All they think of is, to make a convenient plan, and to design a handsome elevation; while the object of the proprietor is, to increase the value of his land, by covering it with houses. The tenant,

allured by a showy exterior, thinks as little of the subject as the proprietor and architect have done, and only finds out his danger when it is too late to save himself without considerable pecuniary loss. What, then, is to be done to secure the public against buildings placed in unhealthy situations? Are we to have a metropolitan board or commission; or some public officer appointed to superintend these things? Or, should a survey be made, by order of government, of the suburbs of the metropolis, and of all large towns, and those places pointed out on a map which are fit for building, and also those which are unfit? Something, no doubt, might be done by having a commission, or a public officer, to refer to; but the grand remedy for every evil of this kind is, as it is for most others, the spread of knowledge; and, in this case, the general enlightenment of the public, with regard to the requisites for insuring health, is the kind of knowledge wanting. This can only be acquired effectually in youth; and the time will, no doubt, come, when it will be made a part of every one's education. In the meantime, the public must suffer, and gain knowledge by experience; unless they should be so fortunate as to meet with such books as *Combe's Constitution of Man*, *Clark on Climate*, *M'Culloch on Malaria*, and others, which treat expressly of the healthiness and unhealthiness of soils and situations.

Ibid.

Mechanics' Register.

New Material for Sheathing Ships' Bottoms.

A few years ago, a patent was obtained for a metal, wherewith to cover the bottoms of vessels, and which promised all the advantages of copper, with at least equal durability in any climate, and a considerable saving in cost. It consists of an amalgamation of metals, copper itself being the principal, and zinc probably (for we are not in the secret) forming one of the ingredients. It is manufactured in sheets in the same manner as copper, and from its resemblance to yellowish tinted brass, has obtained the name of "yellow metal." Several vessels belonging to this port, and others of London, were plated with it some years ago; but it was found to be less ductile than copper, and therefore less suitable for being laid round angles, or into the grooves or hollows of the stern-post or rudder, where the rudder irons (or rather coppers) are attached. In some instances, too, when it required renewing, it was found, on taking it off, that it had, to a considerable degree, perished, having become so brittle, and full of minute pores, that, to use the word of a seamen, who examined it, "it broke in the fingers like a piece of gingerbread." This was, however, in the comparative infancy of the invention, and before proper proportions of materials, of which the metal was composed, had been proved by the test of experience; and the friend of science and of commerce will, doubtless, be gratified to learn that such improvements have since been made, as will, in all probability, ere long, render the use of the "yellow metal" almost universal in our mercantile marine, as at once combining economy with durability. The metal is now made sufficiently ductile for sheathing; several fine large ships have been bottomed with it within the last few months, and it is so rapidly gaining ground in the estimation of navigators, that we are informed Messrs. Pascoe Grenfell, and Sons, copper dealers, have, during the last half year, done much more business in the article than in copper itself. The captains who have lately given it a trial, speak highly of its good qualities; and one vessel plated with it has made three successive voyages from London to

India without requiring any renewal in that particular—showing a durability considerably beyond the copper generally used. The price is 1½d. per lb. cheaper than copper, and it is 6½ per cent. lighter than that metal. It is also found to retain its weight to a greater extent, and the old metal is taken back in exchange by the manufacturers. Another, and perhaps an equally important, use of this metal is, for the bolts or fastenings of ships. From its hardness, when manufactured for this purpose, it is vastly superior to copper, inasmuch as being nearly as hard as iron, it can be driven into a much smaller augur-hole than copper, and to a greater depth in dead wood; forming, consequently, a tighter and stronger fastening, and not so liable to draw, on this account, as well as from the absence of verdegris. From all, indeed, that we can learn, the "yellow metal" may be considered one of the most useful discoveries of modern times in a commercial country like this.

The works are situated within about a mile of the town of Swansea, immediately in the neighbourhood of the copper works (on which we shall have occasion to say something in an early number), and are at present capable of manufacturing a considerable quantity of sheathing and bolts—there being four pair of rollers, with the machinery necessary for drawing rods, worked by an engine of 54½-inch cylinder, 8½-feet stroke. The metal is a combination of copper and zinc, the best admixture being found to be 60 per cent. of the former and 40 per cent. of the latter. The metal is delivered on the works, and is then submitted in these proportions to the action of a reverberatory furnace, or melted in pots, from which it is cast in plates or bars, according to the object for which the metal is required, whether "bolts" or "sheathing." It is subsequently submitted to heat, and when, as it appeared to us, of a "cherry red," is worked in the cylinders or rollers, or drawn out in rods. The process is in itself exceedingly simple, and affords little novelty to any one accustomed to the manufacture of iron.

Many opinions have been advanced, and doubts expressed, of the advantages (if any) which this metal possessed, while its ductility was questioned, and its permanence only admitted when it had been subjected to the test of some years' application.

It is satisfactory to find that the results have fully realized the sanguine expectations of the patentee; one vessel having made three voyages to India without repairs being required, and another having been sheathed for the past five years with the "yellow metal," and now in good condition, while in the port of Swansea, at the present time, two Hamburgh vessels, the *Kate* and *Anna Louise*, have adopted it. In the instance of the *Kate*, we take the words of the owner, "he has effected a saving on a 400 ton vessel of full 80*l.*;" the difference in the price of copper and MUNTZ's (or yellow metal) sheathing, being three-halfpence per pound less, and the difference in the specific gravity 8 to 9 per cent. With respect to the bolts, we have it on the statements of the shipwrights employed, that they are far superior in driving to those of copper, as possessing more tenacity and firmness. Such are the advantages of the combination of the two metals—copper and zinc; and we may, therefore, hope, that with these advances in metallurgical science, we shall, whatever may the be influx of copper ores from foreign climes, be able still to look to home for our supply of mineral, which shall furnish not only employment to the population in our mining districts, but yield, as it has heretofore done, so considerable a proportion of our national wealth.

Lond. Min. Jour.

Statue of James Watt in Greenock.

The statue of James Watt, by Sir Francis Chantrey, is now placed in the building erected for it in Union street. It is an 8 feet figure, of statuary marble, and weighs upwards of 2 tons, and the pedestal, which is of Sicilian marble, weighs about 3 tons. On the front of the pedestal is the following inscription, from the classic pen of Lord Jeffrey:—"The inhabitants of Greenock have erected this statue of James Watt, not to extend a fame already identified with the miracles of steam, but to testify the pride and reverence with which he is remembered in the place of his nativity, and their deep sense of the great benefits his genius has conferred on mankind. Born XIX January, MDCCXXXVI. Died at Heathfield, in Staffordshire, August XXV., MDCCCXIX." On the right of the pedestal is a shield containing the Arms of Greenock, and on the left, strength and speed. On the back is an elephant, in obvious allusion to the beautiful parallel drawn by Mr. Jeffrey between the steam-engine and the trunk of that animal, which was equally qualified to lift a pin or to rend an oak. Mec. Mag.

Anderson's Steam Carriage.

The steam carriage, or drag, invented by Sir James Anderson, is entirely built of iron, except the wheels, which are of great strength and durability. The frame is perfectly unpliable, though very light, and the axle-tree springs so arranged, that any inequality, or ruts, in the road can have no injurious effect. It is lower and shorter than the stage-coaches, but broader, in order to prevent any possibility of upset; and, although made of iron, the weight leaves no greater track on the road than other carriages—and the face of the wheels being six inches broad, it is expected that they will act as rollers, harden the surface, and not cut into it, as is the case with narrow wheels. The cylinders, or engines, which drive the carriage are twelve inches in diameter, the stroke twelve inches, and the heating surface of the boiler is about 500 feet. The power at all times available is fully equal to sixty-three horses; and the consumption of fuel is so small, that about 2d. per mile will cover the expense. The engine, when at work, burns about a hundred weight of coke per hour. The passenger carriage is to be attached to the drag, and contains room for from thirty to forty persons. It has been built in Dublin, and will be forwarded to London with the drag, after a public trial has been made of both in Dublin. Lond. Mis. Journ.

Gas-Light.

The earliest application of this artificial light, on a large, systematic scale, was made at Manchester; where an apparatus for lighting the great cotton mills of Messrs. Phillips and Lee, was fitted up in 1804 and 1805 under the direction of Mr. Murdoch. A quantity of light, nearly equal to 3000 candles, was produced and distributed in this building. This splendid pattern has been since followed very generally in Great Britain, and more or less in many parts of the continents of Europe and America. By the year 1822 gas-lighting in London had become the business of many public companies. In 1822 there were four great companies, having in all forty-seven gasometers at work, capable of containing 917,940 cubic feet of gas, supplied by 1315 retorts, which generated per annum upwards of 397,000,000

cubic feet of gas, by which 61,203 private lamps, and 7268 public or street lamps, were lighted in the metropolis. Besides these public companies, there were likewise several private ones. Dr. Ure's Dic. of Arts. Ibid.

Safety of Bonds, Bills, &c.

A large banking-house, which has recently been finished in the first style of architecture, consequent upon the improvements in the city, had an immense pit or well dug many feet below the surface, and made water-proof by substantial brickwork. The mouth of the pit opens in the floor of the bank parlour, but, during the hours of business, is effectually covered by the oaken floor. At the close of the day, and in the presence of the responsible parties, the bank books, bonds, bills, notes, security and specie, enclosed in proper receptacles, are placed on the trap over the orifice of the well, and, by the aid of ingeniously contrived machinery, the property is lowered to the bottom, a depth of about 40 feet, the trap-door is secured, and at the opening of the bank in the morning, the property is again raised to suit the purposes of the day. Lond. Morn. Chron. Arch. Mag.

Mr. Crosse's Electrical Experiments.

Tuesday week Mr. Andrew Crosse delivered a lecture on atmospheric electricity, at Taunton, illustrated by a number of beautiful experiments. He illuminated 400 feet of iron chain, hung in festoons about the room, the whole extent being brilliantly lighted at the same instant by the passage through it of the spark from the battery, and melted several feet of wire. Mr. Crosse afterwards detailed the results of many experiments on thunder clouds and mists. By means of a wire apparatus suspended in his park, he had discovered that a driving fog sweeps in masses, alternately, negatively and positively electrified; and once the accumulation of the electric fluid in a fog was so great, that there was an incessant stream from his conductor of sparks, each one of which would have struck an elephant dead in an instant. Lond. Times. Lond. Mech. Mag.

Cement for Paper.

A mode of joining sheets of paper together, was exhibited by Mr. Cooper by which the puckering that is occasioned by paste or glue, or any watery solution, is avoided, and a very neat joint is produced. The cement used is a thick solution of caoutchouc, which being applied to the edges of the paper, is allowed a little time to dry and get sticky before the sheets are joined together. This expedient will be found very useful to the lecturer and the draftsman. Royal Inst. Ibid.

Photogenic Drawing.

Considering that any (however trifling) improvement will not be unacceptable to those of your readers who feel an interest in this art, I have been induced to communicate the following method of preparing the paper, which, after many experiments, I find to succeed best. Wash the paper with a mixture of equal parts of the *white of egg* and *water*, afterwards with the solution of nitrate of silver, fixing the drawing as usual with the iodide of potassium.—H. L. Athenæum. Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, SEPTEMBER, 1839.

Angles reckoned to the right or westward round the circle, asseen in an inverting telescope. ☞ For direct vision add 180° ☜

Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
14	6	21	Im. τ Scorpii	3.4	80°	98°
14	7	48	Em.		267	301
20	12	25	Im. 42 Aquarii	6	123	151
20	13	32	Em.		311	350
23	8	5	Im. 60 Piscium	6	147	98
23	9	0	Em.		281	235
26	9	44	Im. g Pleiadum	5.6	125	283
26	10	38	Em.		71	227
26	9	41	Im. b "	4.5	89	35
26	10	31	Em.		319	263
26	10	6	Im. e "	5	154	253
26	10	48	Em.		98	197
26	10	8	Im. c "	5	122	66
26	11	5	Em.		288	231
29	17	15	Im. 47 Geminorum	6	63	18
29	18	36	Em.		275	285

Meteorological Observations for March, 1839.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	36	37	29.80	29.80	W.	Brisk.		Partially cloudy—clear.
	2	35	57	29 70	29.65	W.S.W.	do.		Clear—cloudy.
	3	24	24	29.70	29.85	N.W.	do.		Flurry of snow—clear.
	4	11	23	30.25	30.25	W.	Moderate.		Clear—do.
	5	19	40	30.15	30.10	W.	Brisk.		Clear—do.
	6	27	47	30.25	30.20	W.	Moderate.		Clear—do.
	7	61	55	29.96	29.85	S.W.	do.		Partially cloudy—hazy.
☽	8	34	53	29.50	29.40	S.E.	do.	.19	Cloudy—rain.
	9	38	49	29.50	29 50	W.	Brisk.		Cloudy—do.
	10	30	34	29 84	29.84	W.	do.		Clear—do.
	11	22	36	29 94	29 94	W.	do.		Clear—do.
	12	24	43	30.00	30 15	S.W.	Moderate		Clear—do.
	13	28	52	30 30	30.25	S.W.	do.		Clear—do.
	14	26	46	30.20	30.25	S.W.	do.		Clear—do.
⊗	15	32	52	30.10	30.00	S.E.S.	do.		Cloudy—clear.
	16	36	48	30.00	30.00	S W.	do.		Clear—do.
	17	42	53	30.00	30.00	S.E S.W.	do.		Cloudy—lightly do.
	18	42	70	29.90	29.80	S.E.	do.		Cloudy—hazy.
	19	48	52	29.65	29.81	W.N.E.	do.		Cloudy—do.
	20	36	34	30.10	30.15	E.	do.		Cloudy—rain.
	21	36	43	29 90	29.80	E.	do.	.55	Rain—drizzle.
☾	22	34	52	29.70	29 70	W.	do.		Foggy—clear.
	23	42	48	29.65	29.60	N.E.	do.		Cloudy—do.
	24	32	48	29.80	29.85	W.	do.		Clear—do.
	25	34	40	29.65	29 80	N.W.	Brisk.	.09	Snow—flying clouds.
	26	29	51	30.00	29 96	W.	do.		Clear—do.
	27	43	68	29 75	29.75	W.	do.		Lightly cloudy—clear.
♉	28	50	75	29.80	29.85	S.W.	Moderate.		Clear—hazy.
	29	52	74	29.80	29.75	S.	Brisk.		Cloudy—flying clouds.
	30	43	42	29.86	30.10	W.	do.	.02	Rain—flying clouds.
	31	30	47	30.04	30.45	E.	do.		Clear—do.
	Mean	33.81	48.16	29 90	29.92			.85	

	Thermometer.		Barometer.
Maximum height during the month.	75.	on 28th.	30.45 on 31st.
Minimum " " "	11.	4th.	29.40 8th.
Mean	35.985		29.91

ERRATA.—The Table of Lunar Occultations in the last number was, by error of the press, marked for July instead of August.

Page 7, line 12, of the present number, for *carbonic acid* read *ammonia*.

Lines 32, 33, and 34, on the same page,—the sentence is improperly divided and punctuated: it should read—*Since by its conversion into carbonic acid, oxygen undergoes no change of volume, fifteen measures out of the thirty five were to be ascribed to oxygen consumed by hydrogen.*

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

JULY, 1839.

	County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.	Barome 7, A. M.	2, P. M.	9, P. M.	Maximum.
1	Philadelphia,																
2	Montgomery,																
3	Bucks,	Newtown,	L. H. Parsons.														
4	Lehigh,																
5	Northampton,																
6	Monroe,	Stroudsburgh,	A. M. Stokes.	65.39	83.93	69.26	91.	56.	72.86	.	.....	.....	.	29.34	29.31	29.30	29.75
7	Pike,																
8	Wayne,																
9	Susquehanna,	Silver Lake,	E. Rose.	66.48	74.84	76.81	86.	57.	70.70	.	52.	63.58	.	28.07	28.07	28.04	28.30
10	Luzerne,																
11	Schuylkill,	Pottsville,	John Porter.	67.68	78.31	68.32	87.	59.	71.44	.	45.	57.65	.	29.17	29.15	29.17	29.88
12	Berks,	Reading,	C. F. Egelman.	71.77	78.35	67.45	87.	59.	72.52	.	....	.....	.	29.73	29.67	29.67	30.
13	Chester,																
14	Delaware,	Haverford,	Haverford School,	71.00	79.78	71.55	86.	58.	74.11	3⅔	57.	66.61	1	29.55	29.54	29.56	29.86
15	Lancaster,	Lancaster,	Conservatory of Arts,	69.61	81.30	71.14	91.	61.	74.02	.	56.	66.24	.	29.49	29.48	29.48	29.75
16	York,	York,	Calvin Mason.	77.71	82.06	73.08	90.	63.	77.62	.	56.	65.39	.	29.53	29.53	29.54	29.80
17	Lebanon,																
18	Dauphin,																
19	Northumberland	Northumberland	Andrew C. Huston.	69.48	78.79	70.05	85.	56.	72.77	.	50.	61.26	.	29.43	29.41	29.41	29.71
20	Columbia,																
21	Bradford,																
22	Tioga,																
23	Lycoming,																
24	Union,																
25	Mifflin,	Lewistown,	J. Culbertson, M. D.	73.10	77.93	75.26	86.	67.	75.43	.	....	.....	.	29.28	29.27	29.24	29.53
26	Juniata,	Mifflintown,	J. S. Kinkead.	70.74	77.85	73.24	85.50	62.	73.94	1	....	.....	.	29.46	29.45	29.41	29.71
27	Perry,																
28	Cumberland,	Carlisle,	Prof. W. H. Allen.														
29	Adams,	Gettysburgh,	Prof. M. Jacobs.	68.78	80.41	70.00	87.50	59.50	73.06	.	52.50	62.33	.	29.40	29.37	29.39	29.68
30	Franklin,	Chambersburg,	Alex Thompson, Jr.	71.37	83.90	72.13	91.	63.	75.80	8⅓	....	....	.	29.29	29.27	29.27	29.61
31	Huntingdon,																
32	Centre,	Bellefonte,	John Harris.	66.13	80.08	67.63	91.	46.	71.28	2	40.	55.96	7	29.23	29.22	29.23	29.51
33	Potter,																
34	M'Kean,	Smithport,	Richard Chadwick.	61.77	76.89	61.08	92.	50.	66.58	4⅔	40.	54.50	5	28.26	28.25	28.25	28.48
35	Clearfield,																
36	Cambria,																
37	Bedford,																
38	Somerset,																
39	Indiana,																
40	Jefferson,	Rose Cottage,	C. C. Gaskell.	61.87	77.87	64.81	88.	54.	61.18	⅓	....	....	.	28.89	28.90	28.88	29.30
41	Warren,																
42	Venango,																
43	Armstrong,																
44	Westmoreland,																
45	Fayette,																
46	Green,																
47	Washington,																
48	Alleghany,																
49	Beaver,																
50	Butler,																
51	Mercer,																
52	Crawford,																
53	Erie,																

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Day.	H'r.	M.	Thermometer.				Register.			Barometer.						
		9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Lowest.	Mean.	Days omitted.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.
14	6															
14	7															
20	12															
20	13															
23	8															
23	9															
26	9															
26	10	.26	91.	56.	72.86	.	.....	.....	.	29.34	29.31	29.30	29.75	29.	29.32	.
26	9															
26	10															
26	10	.81	86.	57.	70.70	.	52.	63.58	.	28.07	28.07	28.04	28.30	27.85	28.06	.
26	10															
26	10	.32	87.	59.	71.44	.	45.	57.65	.	29.17	29.15	29.17	29.88	28.86	29.16	.
26	11	.45	87.	59.	72.52	.	....	.....	.	29.73	29.67	29.67	30.	29.47	29.69	.
29	17															
29	18	.55	86.	58.	74.11	3⅓	57.	66.61	1	29.55	29.54	29.56	29.86	29.19	29.55	4
		.14	91.	61.	74.02	.	56.	66.24	.	29.49	29.48	29.48	29.75	29.16	29.48	.
		.08	90.	63.	77.62	.	56.	65.39	.	29.53	29.53	29.54	29.80	29.30	29.53	.
		.05	85.	56.	72.77	.	50.	61.26	.	29.43	29.41	29.41	29.71	29.10	29.42	.

Moon.	Days															
	1															
	2															
	3															
	4															
	5	.26	86.	67.	75.43	.	....	.....	.	29.28	29.27	29.24	29.53	28.49	29.26	.
	6															
☽	7	.24	85.50	62.	73.94	1	....	.....	.	29.46	29.45	29.41	29.71	29.11	29.44	6
	8															
	9															
	10															
	11	.00	87.50	59.50	73.06	.	52.50	62.33	.	29.40	29.37	29.39	29.68	29.08	29.39	.
	12															
	13	.13	91.	63.	75.80	8⅓	....	....	.	29.29	29.27	29.27	29.61	29.01	29.08	8⅓
	14															
⊗	15	.63	91.	46.	71.28	2	40.	55.96	7	29.23	29.22	29.23	29.51	28.94	29.23	2
	16															
	17															
	18	.08	92.	50.	66.58	4⅔	40.	54.50	5	28.26	28.25	28.25	28.48	28.02	28.05	4⅔
	19															
	20															
	21															
☾	22															
	23															
	24															
	25	.81	88.	54.	61.18	⅓	....	....	.	28.89	28.90	28.88	29.30	28.50	28.89	⅓
	26															
	27															
☉	28															
	29															
	30															
	31															
	Mean															

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er.			Weather.								Winds.																Hygrometer.					
Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
9.	29.32	.	9	21	1	7	....	....	4	2.670	4 1/3	.	3/5	.	.	.	1 1/3	.	1 2/3	.	7 1/3	2 1/3	8	1 2/3	3 1/2	.	.		....	.	.....	65.85	11	788
7.85	28.06	.	12	19	.	5	....	....	..	2.220	.	.	.	.	.	.	.	.	5 1/3	2/3	15 2/3	1	3 2/3	.	4 2/3	.	.	.	....	.	.....	....	.	787
3.86	29.16	.	15 1/3	15 2/3	.	12	....	....	..	6.995	1 1/3	.	1/2	.	1/2	.	1	.	.	.	4 1/3	.	8	.	6 1/3	.	9 1/2	.	....	.	.....	....	.	784
9.47	29.69	.	16 2/3	14 1/3	.	9	....	....	6	4.999	.	.	.	.	1 1/3	.	.	.	2/3	.	10	2/3	4	2	11 1/3	.	1	.	....	.	.....	....	.	785
9.19	29.55	4	11	15 1/3	4 2/3	15	....	....	1	3.743	.	.	2	.	1/3	.	2	.	2/3	.	6	.	8	2/3	10 1/3	.	1/3	2/3	65.63	1	.....	....	.	789
9.16	29.48	.	14 2/3	13	3 1/3	12	....	....	4	3.608	3	.	1	.	1/3	.	1 2/3	.	6	2 2/3	5	1	2 1/3	2/3	6	1	.	1/3	65.69	.	.....	70.85	.	815
9.30	29.53	.	.	.	.	6	....	....	1	2.361	1/3	.	1/3	.	2/3	.	1/3	.	.	.	2 2/3	.	3	1/3	22 1/3	1	.	.	52.34	.	.....	....	.	811
9.10	29.42	.	9	22	.	10	....	....	4	7.337	3 1/3	.	1/3	.	1/3	.	2	2/3	8	.	1/3	1/3	3	2/3	3 1/3	1/3	8 1/3	.	....	.	.....	69.66	.	783
9.49	29.26	.	9 2/3	8 1/3	12 2/3	....	....	....	..	....	.	.	4	.	1/2	.	1	.	1/3	.	18 2/3	2	1/3	1/2	3 1/3	2/3	.	.	....	.	.....	....	.	794
9.11	29.44	6	6	14	11	6	...	...	3	4.280	.	.	1 1/3	.	.	.	2 1/3	.	.	.	5 1/2	.	1	.	5	.	11	5	....	.	.....	....	.	779
9.08	29.39	.	15 1/2	15 1/2	.	3	....	....	12	4.517	2 1/3	1	.	.	.	.	1/2	2/3	4 2/3	2 2/3	5 1/3	1 2/3	3 2/3	1	2 1/3	2 1/3	3	.	63.02	.	.....	71.91	.	786
9.01	29.08	8 2/3	9	13 1/3	8 2/3	....	....	....	..	....	.	.	.	.	.	.	1 1/3	.	.	.	9 1/3	.	1 1/3	.	2 2/3	.	1 1/3	15	64.50	9	.....	70.09	10	780
9.94	29.23	2	9 2/3	19 1/3	2	....	....	....	..	5.755	3	.	2 1/3	.	.	.	2/3	.	2	2/3	9 2/3	2/3	5 1/3	.	4	2/3	.	2	....	.	.....	....	.	831
9.02	28.05	4 2/3	8 1/3	18	4 2/3	19	....	....	..	7.372	1/3	.	1/3	.	2 2/3	.	1 2/3	.	2/3	.	3	.	14	.	2/3	.	3	4 2/3	72.06	16	.....	73.72	6	798
9.50	28.89	2/3	14 2/3	15 2/3	2/3	....	...	....	..	8.933	.	.	1/3	.	.	.	1/3	.	1	.	1	.	3 1/2	.	.	.	24	1	....	.	....!	....	.	808

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